

PROLIFERATING THE ESSENCE OF MOKAUEA:  
PERFORMATIVE SYMBIOSIS OF A COASTAL HABITAT

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To quote an intelligent man, “Dreams do come true (for parents).”

Love you... always.

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from the bottom of my heart.

## **ABSTRACT**

Within the city of Honolulu, Hawaii, amidst a plethora of man-made, heavy-handed engineering projects, survives the remnants of a Native Hawaiian fishing village, located on a tiny island within Ke'ehi Lagoon, Mokauea. Currently serving as a physical representation or remembrance of a generation past, deep-seeded in Native Hawaiian maritime culture, the reality of climate change threatens its continued existence. Scientific projections validate the inevitability of a rise in sea level that will result in the complete submergence of the island with the next century. The purpose behind this research and design project is to explore and propose a solution that proliferates the essence of Mokauea.

As mainstream adaptation strategies may be unsuitable for culturally rich and distinctive indigenous peoples, it becomes important to identify and understand the specific and inherent culture, community and environment of Mokauea. Through the formation of a sense of place, a perspective is formed that leads to responsive, responsible and sensitive design.

The proposed design is described as a Water Network Experience that celebrates the natural beauty of Mokauea and Ke'ehi Lagoon, promotes engagement, is environmentally and culturally sensitive. Using a combination of performative design interventions and the creation of various platforms to support education and awareness, the Water Network Experience embraces sea level rise while integrating within the physical and cultural community, using a 21<sup>st</sup> century approach to the translation or interpretation of the past and the anticipation of future scenario, extending historic cultural knowledge to future generations. The Water Network Experience while derivative of the current efforts to preserve or revitalize Mokauea, and shaped by the understanding of sense of place, has the potential to be further investigated, implemented and replicated along the coastlines of Hawaii and throughout the world.

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# INTRODUCTION

## BACKGROUND

Indigenous peoples are exemplified through rich culture, resilience, and adaptive nature. Guided by a different worldview, their invaluable knowledge and relationship to the environment have allowed sustained continuance until recent times. A shift in climate is threatening their existence, petitioning for an integrative adaptation strategy. Understanding the needs of indigenous peoples warrants an investigation into the nature of indigenous culture, beliefs and practices, as well as the forces acting upon them. Therefore, an architectural adaptation strategy addressing the effects of climate change for indigenous peoples, requires the identification of suggestive inclusive components including the knowledge of:

- Indigenous culture, beliefs, values, and practices
- Scientific climate change
- Indigenous climate change
- Current climate change adaptation strategies

## OBJECTIVES

Initial research serves to provide insight into enhancing adaptive capacity and resilience in relation to climate change as well as social or cultural proliferation, and is guided by the following questions:

- What are the causes, effects, proof, and projections of climate change?
- What are the currently proposed mitigation and adaption strategies, in particular, in proposal to rising ocean levels?
- Can the same solutions be applied to indigenous cultures and environments?
- What are the parameters for the design of sea-level rise with adaptive capacity within a coastal area?
- Can architecture provide a solution or bridge to perpetuate cultural or historic preservation and survival through modernization and climate change?

## RESEARCH METHODOLOGY

- Interpretive Historical Research: Indigenous based ways of knowing are stored in songs, chants, stories, and are relatively undocumented officially. This knowledge is an important lens to witness the adaptive capacity of indigenous peoples and their relationship to the environment.

- **Precedents Research:** Taking cues from various adaptive strategies to define the appropriate solution. Precedents were chosen based on a hard-soft scale. This research also explores ocean-based architecture technology and construction methods.
- **Qualitative Research:** To better understand the significance of Mokauea Island and the needs and wants of the people, both an anonymous public user survey and a more in depth interview with residents and affiliated members of Mokauea Island were conducted. Inquiries ranged from involvement with preservation efforts to feelings on new development or redevelopment, and included other pertinent information.
- **Secondary Data Research:** Mapping and analysis of scientific data related to climate change and sea level rise in particular.

The research project began as introspection into the realm of water-based architecture. Highly technical, the research lacked for a better word, depth, or character. While the viability of floating architecture is a definite possible solution for sea level rise through the age of climate change, there was a need to focus on more than just a retreat strategy. Sea level rise gives an opportunity to design from a different perspective, highlighting the existence of a symbiotic relationship between man and nature, especially within the flux of coastal areas. The goal was to further the research based on a site-specific location based in Hawai'i working within the framework of sense of place, which includes aspects of culture, community, and the environment.

## **GOALS**

The focus of research is centered on Mokauea Island, Oahu, Hawaii. Promoted as one of two remaining traditional Hawaiian fishing villages within the state of Hawaii, Mokauea has a rich history within the traditional Hawaiian community. The physical existence of Mokauea Island is threatened by sea level rise, and as a culturally historic place candidate, demonstrates the necessity and importance for perpetuation.

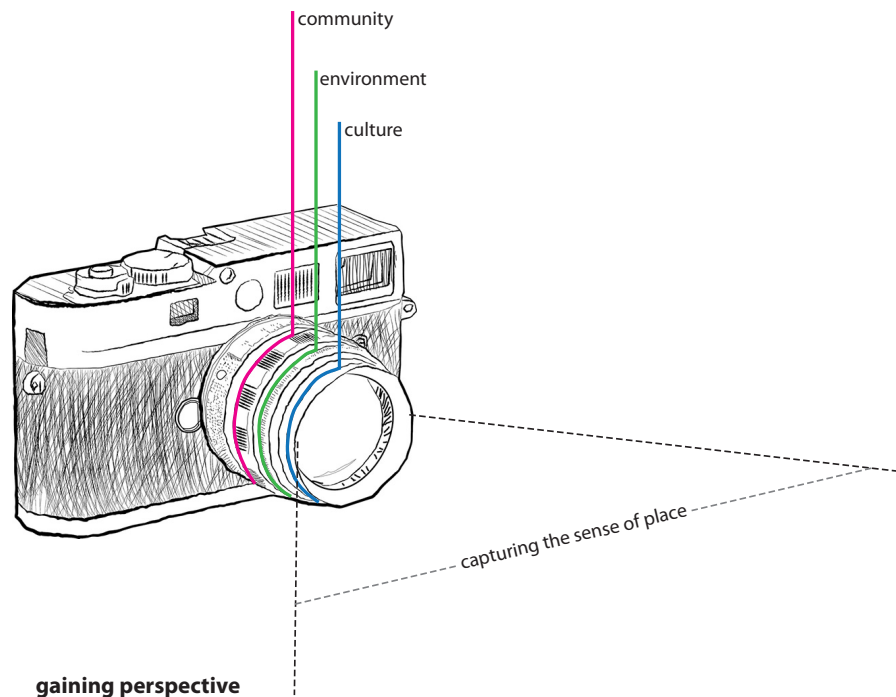
The research conducted in this document focuses on human and nature integration and the survival of indigenous cultural history through the effects of climate change using multiple perspectives to transform a built environment, inspired by the beliefs, practices, and continuation of the Native Hawaiian people, and based off of the principles guided by sense of place. Sense of place is the essence of a specific physical location within a specific environment infused with a specific culture serving a specific community. Working together, a

relationship is formed that embraces the uniqueness of specific locations that allows for the formation of identity, awareness, and responsible or sensitive decision-making.

The resulting proposed or suggested design is the manifestation of research conducted on Native Hawaiian culture, existing and proposed community integration, geographical location, environment, and climate change. The design focuses on interaction or integration with water, performative attributes, education, and awareness, using a combination of hard and soft solutions that are site sensitive and site appropriate. Research and the proposed design solution will serve as a microcosm for other indigenous communities and coastal communities both within Hawaii and throughout the world, creating a platform for awareness that goes beyond preservation or retreat.

### Structure of Thesis

The research design project will be structured to gain a perspective on the area using the lens of sense of place, identified as a combination of culture, community and environment. The research portion of the dissertation will analyze each component to gain a holistic perspective, informing and contributing to create a seamless relationship between design inventions and interventions within the existing context.



**Figure 1: Sense of Place**  
[Graphic by author]

## CHAPTER 1. NATIVE HAWAIIAN CULTURE

Hawaii retains its uniqueness through an acute sense of place, manifested into a perspective, shaped by culture (including history, beliefs, practices, values), community, and physical location or environment, into an interwoven connection built by these relationships. The objective is to create a framework, investigating the elements that contribute towards the creation of sense of place, beginning with Native Hawaiian culture.



**Figure 2: Hawai'i Coastline**

[Image by image kid, <http://imgkid.com/hawaii-beach-sunset.shtml>, edited by author]

### HISTORY

Hawaii's history has been primarily represented, studied and validated by Western post-contact documentation. Native Hawaiian culture did not historically or traditionally utilize a written form of transmittal or recording, instead relying on memorization and oratory devices including: chants, prayers, hulas, and songs. The collaboration of scientific or Western documentation as well as Native Hawaiian knowledge provides an authentic historic worldview of Hawaii not based on assumptions or prejudices.

## **Brief Timeline<sup>1</sup>**

|            |  |
|------------|--|
| 500 - 1250 | Polynesia Migration to Hawaii  |
| 1778       | Arrival of Captain James Cook, first contact between Native Hawaiians and Europeans  |
| 1778-1878  | Tuberculosis, measles, smallpox, and syphilis killed 90% of population   |
| 1810       | Hawaiian Islands united under King Kamehameha I, monarchy established  |
| 1820       | Arrival of first missionaries spread Christianity, downfall of Hawaiian culture including beliefs, practices, and language |
| 1850       | Legislature approval of labor immigration  |
| 1893       | Overthrow of Queen Lili'uokalani   |
| 1941       | Bombing of Pearl Harbor  |
| 1959       | Statehood  |
| 1970s      | Resurgence of activism among Native Hawaiian people  |

## **SCIENTIFIC DOCUMENTATION**

By western definition, Hawaii became the 50<sup>th</sup> state of the United States of America, under Dwight D. Eisenhower on August 21, 1959. The State of Hawaii encompasses most of the Hawaiian Archipelago, including a total of more than 130 scattered landmasses and 8 main islands.<sup>2</sup> According to the United States Census Bureau, in 2013 the State of Hawaii supported an ethnically diverse population of 1.4 million residents, and despite the recent addition to the

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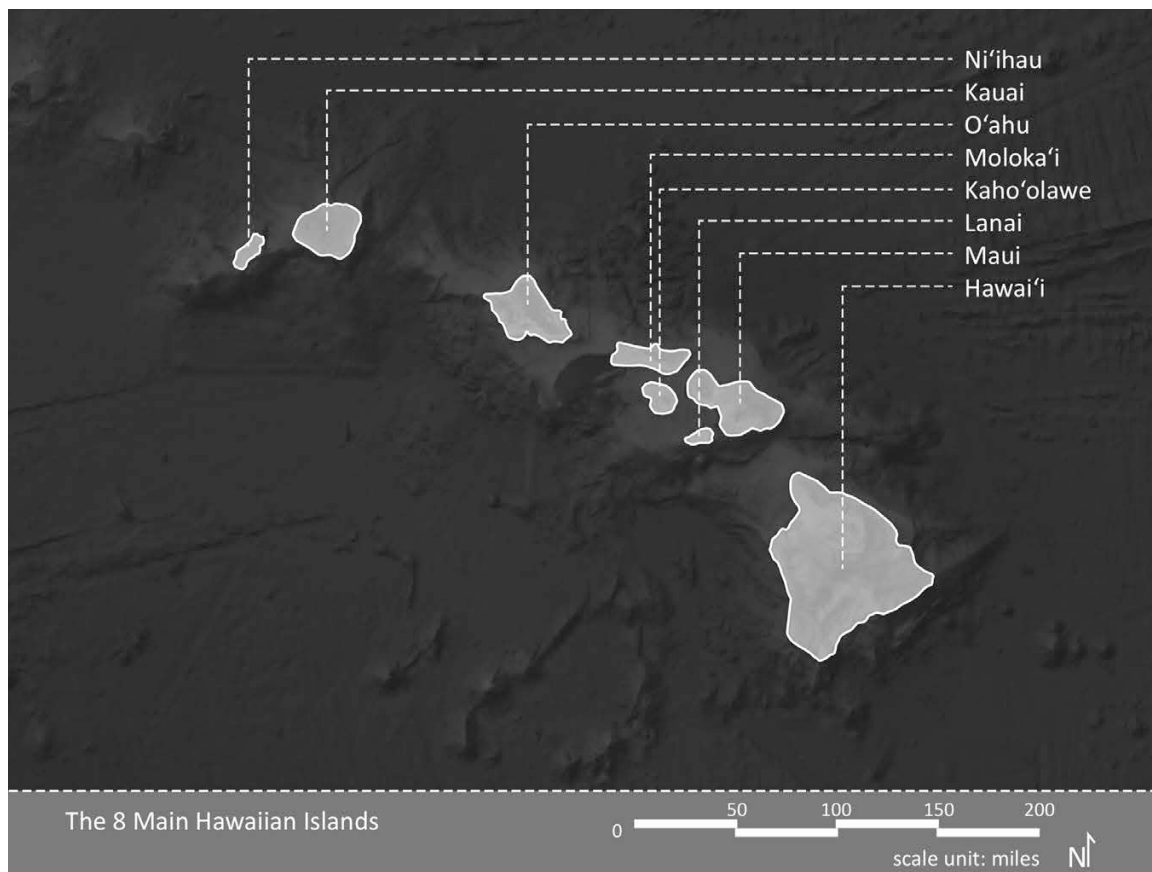
<sup>1</sup> Donald D. Kilolani Mitchel, *Resource Units in Hawaiian Culture* (Honolulu, Hawaii: Kamehameha Schools, 1992), 9-16.

<sup>2</sup> "Hawaii," Infoplease, accessed January 2, 2015, <http://www.infoplease.com/us-states/hawaii.html>.



United States, Hawaii while being the 8<sup>th</sup> smallest and 11<sup>th</sup> least populous, is the 11<sup>th</sup> largest metropolitan area.<sup>3</sup>

Although traditionally a self-sustaining agrarian society, according to an article printed in the *Hawai'i Tribune Herald*, Senate Bill 937 (aimed to boost Hawaii's food resiliency) reads, "As the most geographically isolated state in the country, Hawaii imports approximately 92 percent of its food, according to the Pacific Regional Integrated Sciences and Assessments Program".<sup>4</sup> Western development has created an economy that is now primarily based and dependent on tourism and military presence and spending. Colonization and Westernization permanently altered traditional Hawaii physically, socially, politically, and economically.



**Figure 3: The 8 Main Hawaiian Islands**  
[Image from Google Maps, graphic by author]

<sup>3</sup> "United States Census Bureau," Hawaii QuickFacts from the US Census Bureau, accessed September 20, 2014, <http://quickfacts.census.gov/qfd/states/15000.html>.

<sup>4</sup> "Bills Promote Food Self-Sufficiency," *Hawaii Tribune-Herald*, March 3, 2013, accessed January 3, 2015, <http://hawaiitribune-herald.com/sections/news/local-news/bills-promote-food-self-sufficiency.html>.

Prior to Western contact, Native Hawaiians inhabited the islands for over 1500 years. Scientific and archeological research uses geological, archaeological, zoological, botanical, and linguistic evidence to trace Polynesian migration patterns including the origin of Native Hawaiians.<sup>5</sup> The Polynesian triangle is used to describe the greatest migration in human history as Polynesians traveled thousands of miles by boat to uninhabited lands, demonstrating exceptional seafaring, maritime, and navigational skills. In *Resource Units in Hawaiian Culture*, Dr. Kenneth Emory endorses the settlement pattern diagrammed in Figure 4 and as described below.<sup>6</sup>

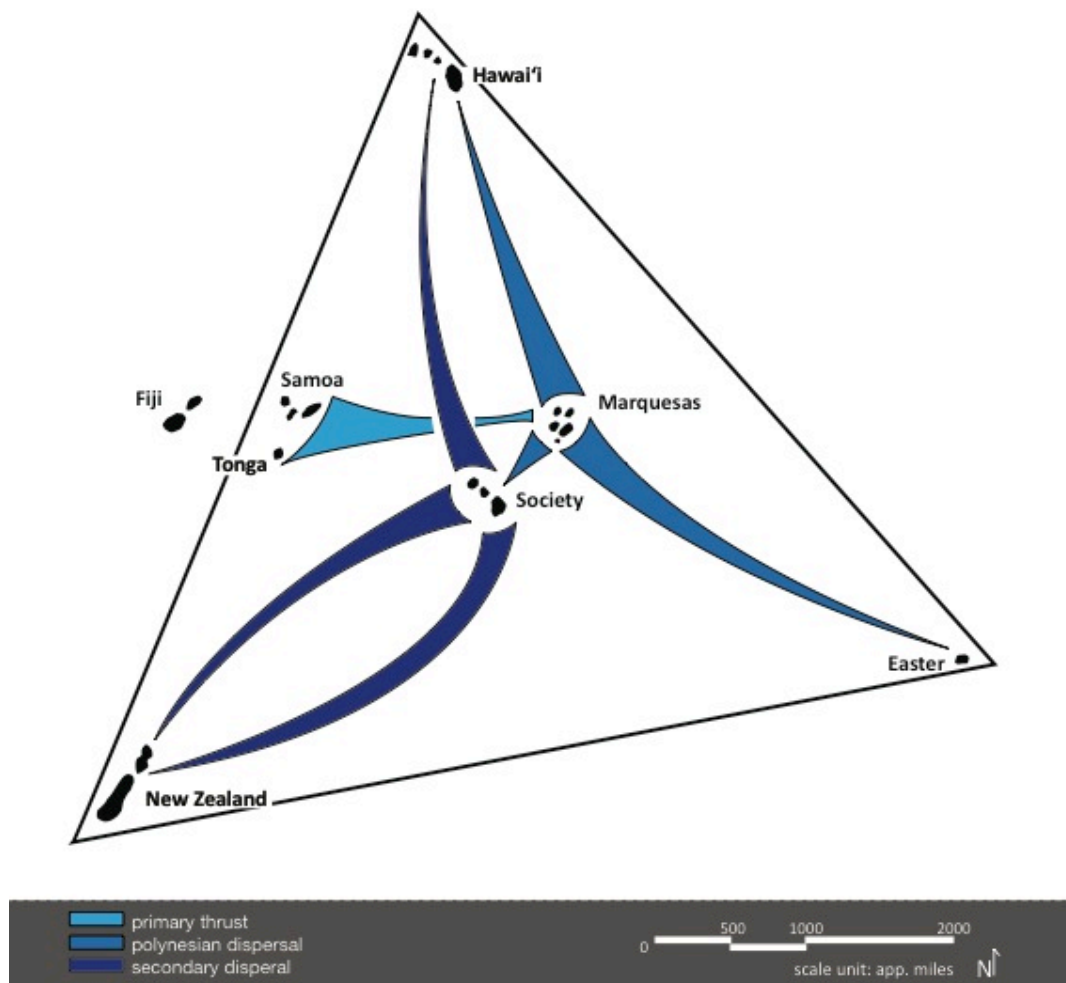
### **Polynesian Settlement Pattern**

|              |   |
|--------------|---|
| 1500BC       | Southeast Asia to Tonga                       |
| 1500BC       | Tonga to Samoa                                |
| 1 AD         | Samoa to Marquesas Islands                    |
| 300 AD       | Marquesas Islands to Society Islands          |
| 500 AD       | Marquesas Islands to Easter Island (Rapa Nui) |
| 500-750 AD   | Marquesas Islands to Hawaii                   |
| 750 AD       | Society Islands (Tahiti) to New Zealand       |
| 1000-1250 AD | Society Islands (Raiatea) to Hawaii           |

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<sup>5</sup> "SEA Semester | Study Abroad with SEA Semester: Ocean Science & Sailing Program - Nautical, Maritime, & Oceanography Studies | SPICE Atlas Project: Rangiroa," SEA Semester, accessed September 27, 2014, [http://www.sea.edu/spice\\_atlas/rangiroa\\_atlas/polynesian\\_migration](http://www.sea.edu/spice_atlas/rangiroa_atlas/polynesian_migration).

<sup>6</sup> Donald D. Kilolani Mitchel, *Resource Units in Hawaiian Culture*, 9-16.



**Figure 4: Polynesian Migration Triangle**

[Data from *The Journal of the Polynesian Society*, <http://www.jps.auckland.ac.nz>, graphic by Author]

The arrival of Captain Cook in 1778 ignited change. The introduction of western foreigners can be determined to be the reason behind the fall of the Native Hawaiian Culture including: the ban of Native language, hula, military, the introduction of foreign diseases, and the introduction of a new culture and religious system.<sup>7</sup> The introduction and integration of Western foreigners within an established and equally complex yet different indigenous society prompted a new era for Native Hawaiians, challenging traditional ways of life. While there are varying degrees of indigenous people including: acclimation to modern society, relative isolation, and isolated or uncontacted, regardless of classification, any contact with an outside society results in marginalization. Through colonization and statehood, Western societal practices have

<sup>7</sup> "Hawaii History: Post-Contact," Alternative Hawaii, accessed March 26, 2014, <http://www.alternative-hawaii.com/hacul/history1.htm>.

become the dominant role socially, politically, and economically, causing Native Hawaiians questioning their existence and more importantly, their identity, resulting in a continuous call for cultural revival of traditional Hawaiian beliefs, practices, and values.

## IDENTITY

As discussed earlier, sense of place is characterized by the relationship between geographical or physical location, culture, and community. Native activist, historian and author, George Kanahale explains that, "In the Hawaiian mind, then, a sense of place was inseparably linked with self-identity and self-esteem. To have roots in a place meant to have roots in the soil..."<sup>8</sup>

Congress defines Native Hawaiian as, "Any individual who is a descendant of the aboriginal people who, prior to 1778, occupied and exercised sovereignty in the area that now constitutes the State of Hawai'i."<sup>9</sup> This definition becomes the basis in establishing self-identification, which is vital for cultural proliferation as corroborated from the International Work Group for Indigenous Affairs.

*On an individual basis, an indigenous person is one who belongs to these indigenous peoples through self-identification as indigenous (group consciousness) and is recognized and accepted by the group as one of its members (acceptance by the group). This preserves for these communities the sovereign right and power to decide who belongs to them, without external interference.*<sup>10</sup>

A 15 page document entitled, *United Nations Declaration on the Rights of Indigenous Peoples*, accounts for the rights of indigenous peoples based on political, social, economical, and cultural platform, and is recognized and exercised by the States in accordance with the Charter of the United Nations. Article 43 articulates the content of the document as, "The rights recognized herein constitute the minimum standards for the survival, dignity and well-being of the indigenous peoples of the world."<sup>11</sup> The following selected passages highlight the importance and relevance to this research project.<sup>12</sup>

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<sup>8</sup> George S. Kanahale, *Kū Kanaka-Stand Tall: A Search for Hawaiian Values* (Honolulu: University of Hawaii Press, 1986).

<sup>9</sup> "42 USC 11711: Definitions," Office of the Law Revision Counsel United States Code, accessed October 12, 2014, <http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section11711&num=0&edition=prelim>.

<sup>10</sup> "Who Are The Indigenous Peoples," International Work Group for Indigenous Affairs, accessed August 12, 2014, <http://www.iwgia.org/culture-and-identity/identification-of-indigenous-peoples>.

<sup>11</sup> UN General Assembly, *United Nations Declaration on the Rights of Indigenous Peoples: Adopted by the General Assembly on 13 September 2007, Pocket Sized Format*, ed., Geneva: UHCHR, 2008.

<sup>12</sup> *Ibid.*

*Affirming that indigenous peoples are equal to all other peoples,  
that all peoples contribute to the diversity and richness  
of civilizations and cultures, which constitute the common heritage  
of humankind,*

**Article 25**

*Indigenous peoples have the right to maintain and strengthen their distinctive spiritual relationship with their traditionally owned or otherwise occupied and used lands, territories, waters and coastal seas and other resources and to uphold their responsibilities to future generations in this regard.*

**Article 26**

- 1. Indigenous peoples have the right to the lands, territories and resources which they have traditionally owned, occupied or otherwise used or acquired.*
- 2. Indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired.*
- 3. States shall give legal recognition and protection to these lands, territories and resources. Such recognition shall be conducted with due respect to the customs, traditions and land tenure systems of the indigenous peoples concerned.*

**Article 29**

- 1. Indigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall establish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination.*

Although Native Hawaiians are not federally recognized as an indigenous people, there have been efforts made by the Native Hawaiian population to proclaim sovereignty or self-governance.

**SOVEREIGNTY | LAND RIGHTS**

A significant role in the degradation of identity resulted from the introduction of land ownership brought by Western society. Contact with western society, colonization,

missionaries, the Great Mahele, overthrow of the government, annexation and statehood highlight the political change in Hawaii. Native Hawaiians lost their land, their culture, and self-determination. In the last printed edition of *Mana Magazine*, Dr. Kanu Sai, Ph.D., highlights the indecency that, “What was stolen was the right to self-determination from those who exercised that right at the time,”<sup>13</sup> Within the same article, Ku’uwehi Hiraishi and Ke’ōpūlaulani Reelitz elucidate that, “The path to building a Hawaiian nation will be as unique and complex as the path that brought Native Hawaiians to our current situation.”<sup>14</sup> For the last 30 years, there have been consistent efforts made in the name of Hawaiian sovereignty, but no official ruling or classification. The situation presents similarly to Native Americans who are considered to be indigenous peoples and receive the right to self-determination and other federal aid.

The dispute over land rights within a modern capitalist society may be viewed as a primarily economical battle. The push for self-determination stems from the struggle to recover land, restore a sovereign nation, and perhaps most importantly, retain culture. The ‘āina or land connects past, present, and future, and is rooted within Native Hawaiian Culture.

## **CULTURE**

Culture is the inclusion of knowledge, belief, art, morals, law, custom, and any other capabilities and habits, viewed as a whole.<sup>15</sup> Scientifically, the root word of culture is *colere* (French origin), meaning to tend to the earth, to cultivate, or grow, suggesting a connection to the fostering of growth. Culture therefore is not static, always evolving and transforming, and is influenced by leaders, lifestyle, and foreign cultures among others.<sup>16</sup>

The Native Hawaiian culture, although derivatively driven by other Polynesian cultures through migration patterns, is distinctively unique. Research offers a glimpse, or a lens borrowed to view the world as they did. In lieu of this document, research was focused on selected key elements of traditional or Native Hawaiian culture: beliefs, practices, and values.

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<sup>13</sup> Ku’uwehi Kiraishi and Ke’ōpūlaulani Reelitz, “Self-Determine Nation,” *Mana Magazine*, September 2014, 24-29.

<sup>14</sup> *Ibid.*

<sup>15</sup> David A. Hollinger (ed), *The Humanities and the Dynmaics of Inclusion Since World War II* (Maryland: Johns Hopkins University Press, 2006), 274-276.

<sup>16</sup> “Culture,” Dictionary.com, accessed January 22, 2014, <http://dictionary.reference.com/browse/culture?s=t>.



**Figure 5: The Sharing of Hā, or Breath of Life, shows the highest form of respect**

[Image courtesy of the Star Bulletin, <http://archives.starbulletin.com/2003/09/10/news/story2.html>, edited by author]

## Beliefs

Scientific discovery has led to the validity of the Polynesian migration pattern, and in conjunction, the origination of Native Hawaiians. However, in traditional Hawaiian belief, and as told through the *Kumulipo*, Native Hawaiians did not originate through migration, they were born from the elements.

While scientific research and analysis offer proof of Polynesian migration and origin, the *Kumulipo* offers a different explanation of being, providing a history of the Native Hawaiian peoples through a Native Hawaiian Worldview, offering insight into the beliefs of Native Hawaiian culture. Composed of over 2000 lines within 16 verses or eras of creation, the *Kumulipo* details the origin of the physical world including the human race, and authenticates the genealogy of Hawaiian gods and ancestors.<sup>17</sup> According to numerous resources including the first English translation by Queen Liliuokalani, the *Kumulipo* was composed in 1700 by Ke‘eaumoku and first

<sup>17</sup> “The Kumulipo Translated by Queen Liliuokalani,” Sacred Texts, accessed January 12, 2015, <http://www.sacred-texts.com/pac/lku/>.

recited by Hewahewa and Ahukai at the death of Ke'eaumoku. By account, it was only recited twice more: at the arrival of Captain Cooke, and the death of David Kalakaua.<sup>18</sup>

In Hawaiian tradition the *Kumulipo* was recited orally by memory and passed down through generations as such. It is speculated that the *Kumulipo* has been changed through time and although it is remembered and exists not exactly as composed, the meaning remains. The first written translation was done by Queen Lili'uokalani from brother David Kalakaua's version to authenticate a newly appointed role as King in 1889.<sup>19</sup>

The first 12 lines of the *Kumulipo*:

|                                      |   |
|--------------------------------------|---|
| O ke au i kahuli wela ka honua,      | At the time that the heat of the earth,               |
| O ke au i kahuli lole ka lani,       | At the time when the heavens turned<br>and changed,   |
| O ke au i kuka'iaka ka la,           | At the time when the light of the sun<br>was subdued  |
| E ho'omalalama i ka malama,          | To cause the light to break forth,                    |
| O ke au o Makali'i i ka po           | At the time of the night of Makalii                   |
| O ka Walewale ho'okumu honua ia,     | Then began the slime which established<br>the earth,  |
| O ke kumu o ka lipo,                 | The source of deepest darkness.                       |
| O ke kumu o ka Po, i po ai,          | Of the depth of darkness,                             |
| O ka lipolipo, o ka lipolipo         | Of the depth of darkness,                             |
| O ka lipo o ka la, o ka lipo o ka po | Of the darkness of the sun, in the depth<br>of night, |
| Po wale ho-i                         | It is night,  |
| Hanau ka po                          | So was night born.                                    |

Within the *Kumulipo*, all are born from the same source, po, or night, and therefore, the same thread connects all. Elements were born versus being created, re-emphasizing an intimate connection on a deeper familial premise. The coral polyp was the first living creature to be born, symbolizing the importance and significance of the ocean, and the relationship

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<sup>18</sup> "The Kumulipo Translated by Queen Liliuokalani," Sacred Texts, accessed January 12, 2015, <http://www.sacred-texts.com/pac/lku/>.

<sup>19</sup> "Kumulipo," Maui Community College, accessed February 2, 2015, <http://www2.hawaii.edu/~zinner/101/students/PuaKumulipo/kumulipo.html>.



between land and water, inextricably connected: whatever happens on land affects the ocean, and vice versa. The last to be born was the human race.<sup>20</sup> Through a chronological representation, man is the last to be born, signifying that man is the younger sibling to all living things, implicitly translated as a responsibility to serve older siblings. By observing, listening, and learning from brothers and sisters, in return they care for us and provide man with nourishment. The *Kumulipo* serves as the defining origination of the idea and importance of being stewards of the land.

The connection to the environment, the relationship between humans and nature, also stems from a myriad of beliefs within the Native Hawaiian Culture. Along with the *Kumulipo*, traditional folklore, mo'olelo or stories about creation and origin bring life and give meaning to the land the sea and all living things, creating not just a physical connection, but a spiritual connection to the elements and gods.

According to Native Hawaiian belief, Papahānaumoku and Wakea were the parents of both taro and humans. Through incestuous relations between Wakea and their daughter Ho'ohokulani or one who creates the stars of heaven, was born kalo and equally important, kānaka maoli, or the Native Hawaiian people.<sup>21</sup> Mankind is intrinsically connected to the heavens and sky and the earth creating a symbolic relationship. In modern society, possibly translated from the idea of this connection, while praying, it is customary to take off your shoes and hat as a physical gesture of this connectivity.

Native Hawaiians present as a polytheistic society with a belief in supernatural gods and spirits guided by a unique and simple religious practice. As author and researcher Pali Jae Lee explains, "During these ancient times, the only 'religion' was one of family and oneness with all things. The people were in tune with nature, plants, trees, animals, the 'āina, and each other. They respected all things and took care of all things. All was pono."<sup>22</sup>

## Practices

It is known in current local Hawaiian culture that Native Hawaiians were able to survive off of kalo or taro, and fish, symbolizing the interconnectedness between earth, water, and humans for survival. The simple integral relationship summing the balance, reliance, and

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<sup>20</sup> *Ibid.*

<sup>21</sup> "Papa and Wakea," Sacred Texts, accessed December 4, 2014, <http://www.sacred-texts.com/pac/ku/ku23.htm>.

<sup>22</sup> Pali Jae Lee, *Ho'opono* (Lightning Source Inc., 2007), 28.

symbiosis between man and nature can be seen through the development of the ahupua'a system.

### *Ahupua'a*

Increased population in Hawaii expedited the transition into a stabilized permanent culture, and prompted the development of the ahupua'a system. An ahupua'a incorporates the heavens, the earth, the ocean and all living things stewarded by humans, and is a physical manifestation of the values and beliefs of native Hawaiian culture and spirituality.<sup>23</sup> The ahupua'a was used as a vessel for connectivity between different communities and different parts of the ecosystem. Functionally, the Native Hawaiians used the ahupua'a to develop a system of ruling, land use, and resource management, dividing the land into manageable sections: the island or moku, ahupua'a, ili and mo'o. Physically, an ahupua'a is a segment of land stretching from the mountain to the ocean, following the natural boundaries of the watershed, comprising or encompassing an entire ecosystem.<sup>24</sup> The ahupua'a was further broken down into zones based on vertical location of area and performative attributes.

The area of study for research is located in the kahakai or coastal zone. Within this zone, Mokauea and Ke'ehi Lagoon lie within the kahikohola or shallow sea inside the reef and the moana or ocean zones, for three ahupua'a divisions: the Moanalua, Kahauiki, and Kalihi.<sup>25</sup> A vast shallow reef flat, abundant aquatic life, and productive fishponds allowed Ke'ehi Lagoon to become an essential component of the ahupua'a system.

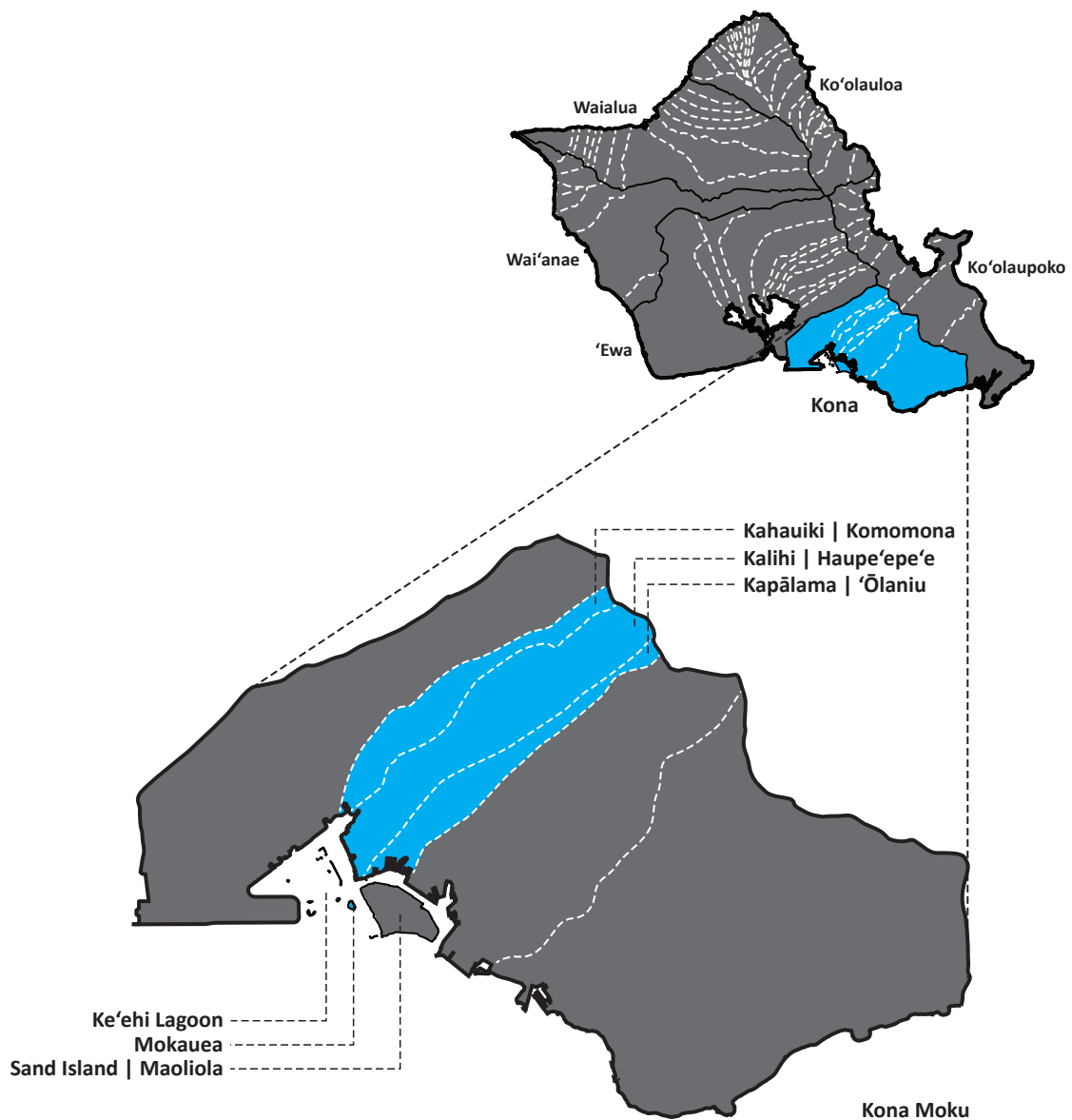
Typical of Native Hawaiian society at large, resources were protected and monitored to ensure availability for future generations. The translation of an ahupua'a into a holistic approach to life emphasizes a responsibility to the environment, definitive of modern sustainability practices.

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<sup>23</sup> "Ahupua'a," Hawaii History, accessed October 22, 2014, <http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&CategoryID=299>.

<sup>24</sup> "Ahupua'a," Hawaii History, accessed October 22, 2014, <http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&CategoryID=299>.

<sup>25</sup> Mary Kawena Pukui, Samuel Hoyt Elbert, Esther K. Mookini and Esther T. Mookini, *Place Names of Hawaii* (Hawaii: University of Hawaii Press, 1974).



**Figure 6: Moku and Ahupua'a Divisions**

[Data from HoLIS, DPP, C&C of Honolulu, <http://gis.hicentral.com>, graphic by author]

In conjunction with the ahupua'a organization, the Kapu system was a series of rules proclaiming what was allowed and not allowed, based on beliefs rooted in the possession of mana or power, bestowed by the gods. The kapu system infused through all segments of daily life, manifesting as restrictions and rules of conduct, rooted in the Hawaiian concept of the universe embodied in the interrelationship of gods, man and nature.

The kapu system can be viewed as a ploy of governance, which it undoubtedly served as, but more importantly, acted as a resource management tool. Restrictions on certain species during specific seasons or times of the year protected the perpetuation of native species, working within rhythms of the natural environment, to ensure the continuance of species for future generations.

### *Language*

The importance of the continuance of an aboriginal language lies in the inherent cultural transfer of beliefs, values, practices, and knowledge. The Native Hawaiian culture is an oral culture. History is recorded through mo'olelo or stories, chants, songs, and through knowledge handed down through generations. As information was not written down or recorded, there have been some disputes on the validity of information. But that is from a western point of view, the need to quantitatively categorize, record, and prove the facts. In Native Hawaiian culture, the spoken word is truth. Although Hawai'i has become a hybridization of cultures, there are devices in which keep the culture alive.

In Hawaii, 86% of place names are in the aboriginal Native Hawaiian Language.<sup>26</sup> *Place Names of Hawaii* by Mary Pukui, is a compilation of place names that "...provide the people of the State of Hawai'i with a glossary of important place names in the state." Place names are important in Native Hawaiian culture as often a story, a meaning, or a descriptive knowledge, is attached to the root word and is used as a way to navigate through space and history.

Pukui acknowledges the disparities in the origin and pronunciation of Hawaiian words as all of Hawaiian knowledge was stored and recited, passed down through the generations using memory. There are some place names that have no meaning within a current knowledge framework. Using scientific breakdown or just does not make sense. It is possible that the meaning has been lost, and therefore the story forgotten, lost through time. Obliteration of natural landmarks and the gradual disappearance of the Hawaiian language has been the cause of some of the correlational meanings being lost, suggesting that there is a strong correlation between the land and culture.

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<sup>26</sup> Katrina-Ann R. Kapa'anaokalaokeola Nakoa Oliveira, "Wahi A Kahiko: Place Names as Vehicles of Ancestral Memory," *AlterNative: An International Journal of Indigenous Peoples*, Vol. 5 Issue 2 (2009), p100.

Therefore the goal of Place Names in Hawaii is to record the names and the lore associated with Hawai'i place names and to ensure that they endure as a part of the English language, and more importantly, within Native Hawaiian culture.

### **Values**

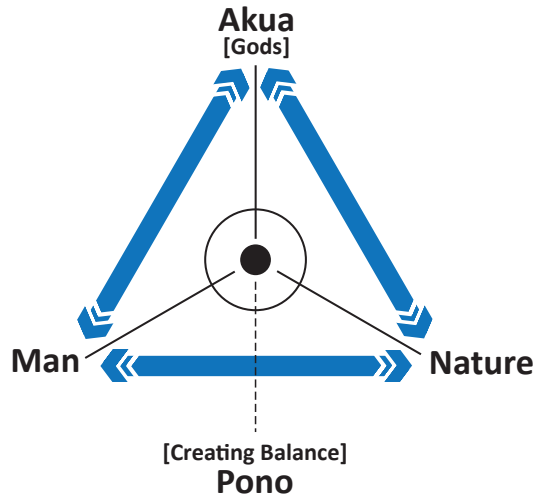
The Native Hawaiian belief system was guided by values and traditions. These principles provided a framework for the creation of relationships needed in everyday life. Many of these principles are basic states of being, reinforcing the importance of a reliance of connectivity.

|                |   |
|----------------|---|
| <b>Aloha</b>   | To love, to be fond of, to show kindness, mercy, pity, charity, affection   |
| <b>Kuleana</b> | To hold right, privilege, concern, responsibility   |
| <b>Mālama</b>  | To take care of, tend, care for, preserve, protect, beware, maintain  |
| <b>Laulima</b> | To cooperate  |
| <b>Lōkahi</b>  | To be in unity, agreement, accord, unison, harmony  |
| <b>Pono</b>    | Proper behavior between people and the land inclusive of the lands reciprocity or actions that assist the universe to function in perfect harmony <sup>27</sup> |

The above principles guide conduct and much like the current role of modern religions, provides a guideline to determine right from wrong, a prescription for doing right. Through these values, a vehicle for the transference and proliferation of cultural knowledge is created, aiding in the formation of identity, and strengthening culture. Hawaiian gods, creation, and the interconnectedness between all living things, are all based on Native Hawaiian cultural values, intrinsically expressed through a way of living. Simplified as a Native Hawaiian Worldview created through the lens of akua or gods, nature, and mankind, this triangle serves as the basis of all relationships and strives for pono or balance.

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<sup>27</sup> Mary Kawena Pukui and Samuel H. Elbert, *Hawaiian Dictionary, Revised & Enlarged Edition* (Hawaii: University of Hawaii Press, 1986).



**Figure 7: Native Hawaiian Worldview Triangle**  
[Graphic by author]

## THE BUILT ENVIRONMENT

There is little evidence and documentation of early Native Hawaiian population settlement. It can be assumed that as agriculture and fishing were sources of sustenance, populations tended to settle around these areas. Early communities were concentrated in the mountains, hillsides, and valleys, in dwellings or shelters known as hale pohaku or house of rocks, inhabiting naturally formed rock caves. Temporary coastal communities associated with fishing grounds were often scattered and temporary forms of dwellings, rectangular in shape. Since the concentration of population for governmental and business purposes was not integral to the functioning society, settlement patterns were often determined by resource proximity, availability of fresh water, shelter from the sun, wind, and rain, and often occupied by multiple generations.<sup>28</sup>

As the population increased, communities grew around coastal fishponds, fertile agricultural regions and eventually expanded into more arid and marginalized areas. Rock caves and lean-to structures slowly evolved into the iconic thatched house recognizable today. The iconic thatch house, symbolizing the permanence of Hawaii residency, are rectangular stone-faced, earth-filled platforms with a tent like structure of wood, finished in thatching.<sup>29</sup>

<sup>28</sup> Linda Wendel Greene, *A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai'i Island* (Denver Service Center: United States Department of the Interior National Park Service, 1993).

<sup>29</sup> Russel A. Apple, *The Hawaiian Thatched House* (United States Department of the Interior, 1971).



The Native Hawaiian lifestyle reflected upon the associated architecture. As majority of daily life was conducted outdoors, buildings were primarily used as shelter from the elements as necessary. Native Hawaiian shelters were simple in design, using natural readily available local materials, and based on the ideals of family or ohana. A kauhale or community or familial complex consisted of single function units or shelters, clustered in an arbitrary arrangement.

**Figure 8: Kauhale Arrangement within an Ahupua'a System**

[Image by Hawaiian Sustainability Foundation, <http://www.hawaiiansustainability.org/ahupuaa.php>, edited by author]

The ending of the kapu system created huge change in the lives and social patterns in Hawaiian culture. The hale noa, separated by function, offered a simple and orderly organization. As explained in *Native Planters*:

*The simplicity and orderliness of the hale noa, and with them the sound, normal living of families, were destroyed when the kapu requiring men and women to eat separately was abolished. This meant that food was brought into the living quarters. What had been a clean and neat sanctum for man and wife and their offspring became a free-for-all gathering place for all ages of both sexes. The integrity and meaning of the home no longer existed; with them vanished the orderliness of 'ohana relationship on which the social and economic functions of the community were built. This was a first symptom of the further deterioration in 'ohana relationships, including that between ali'i and maka'ainana, which was to come about gradually with the later intrusion of foreign and economic and political influences.<sup>30</sup>*

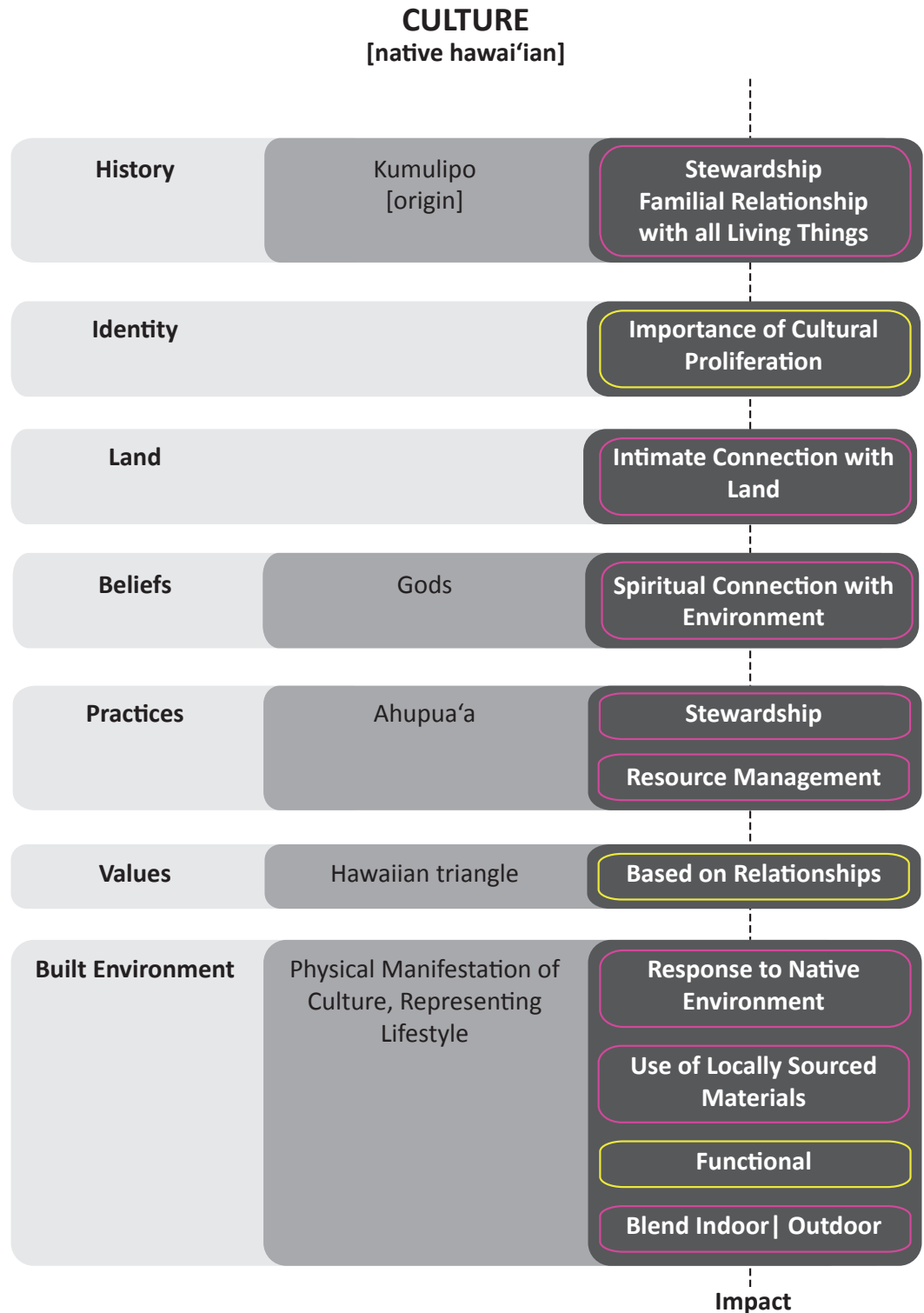
<sup>30</sup> E.S. Craighill Hardy and Elizabeth Green Handy with the collaboration of Mary Kawena Pukui, *Native Planters in Old Hawaii: their Life, Lore, and Environment*, Bernice P. Bishop Museum bulletin 233 (Honolulu: Bishop Museum Press, 1991), 294-295.

Traditionally, architecture in ancient Hawaiian was based on functional need, was a response to natural environmental cues, honest to the materials used, and a representation of the culture and lifestyle of Native Hawaiian peoples and communities. The introduction of a foreign society and culture created change for the Native Hawaiians, which would eventually be the cause of a culture trying to survive.

## **CONCLUSION**

Colonization, statehood, and urban development, has spurred the decline of Hawaiian culture. The understanding of the history, beliefs, values, and practices of Native Hawaiians aid in the formation of a distinct sense of place and should be celebrated, embraced, and perpetuated for future generations. Culture is the direct result of the relationships between humans and their interaction and perception of the world, and defines the qualities and attributes of a community.





note: color-coding aids in organizational structure as illustrated in Chapter 6.

**Figure 9: Conclusion Diagram for Native Hawaiian Culture**

[Graphic by author]

## CHAPTER 2. MOKAUEA



**Figure 10: Mokauea, on the list for endangered historic places in Hawaii**

[Image by Historic Hawai'i Foundation, courtesy of David Croxford, <http://historichawaii.org/2014/12/08/mokauea-island-2014/>]

### INTRODUCTION

In 2014, Mokauea Island joined the list of Hawaii's Most Endangered Historic Places as determined by the Historic Hawai'i Foundation. According to their website, "The intent of the Most Endangered list is to bring attention to these sometimes overlooked or forgotten areas to remind people of their history, how they relate to real people and events, and how they shaped and influenced both their generation and contemporary life. The list highlights threats to historic places that occur from a variety of sources, including neglect, natural disaster, deliberate demolition and incompatible new development. The list is intended to rally the community to take action to ensure these community landmarks are saved."<sup>31</sup>

As an important component of sense of place, this chapter presents an understanding of the neighborhood dynamics and components of not only Mokauea Island, but also the larger contextual Ke'ehi Lagoon area, in order to identify the significance, remember the history, and respect existing functions and community dynamics.

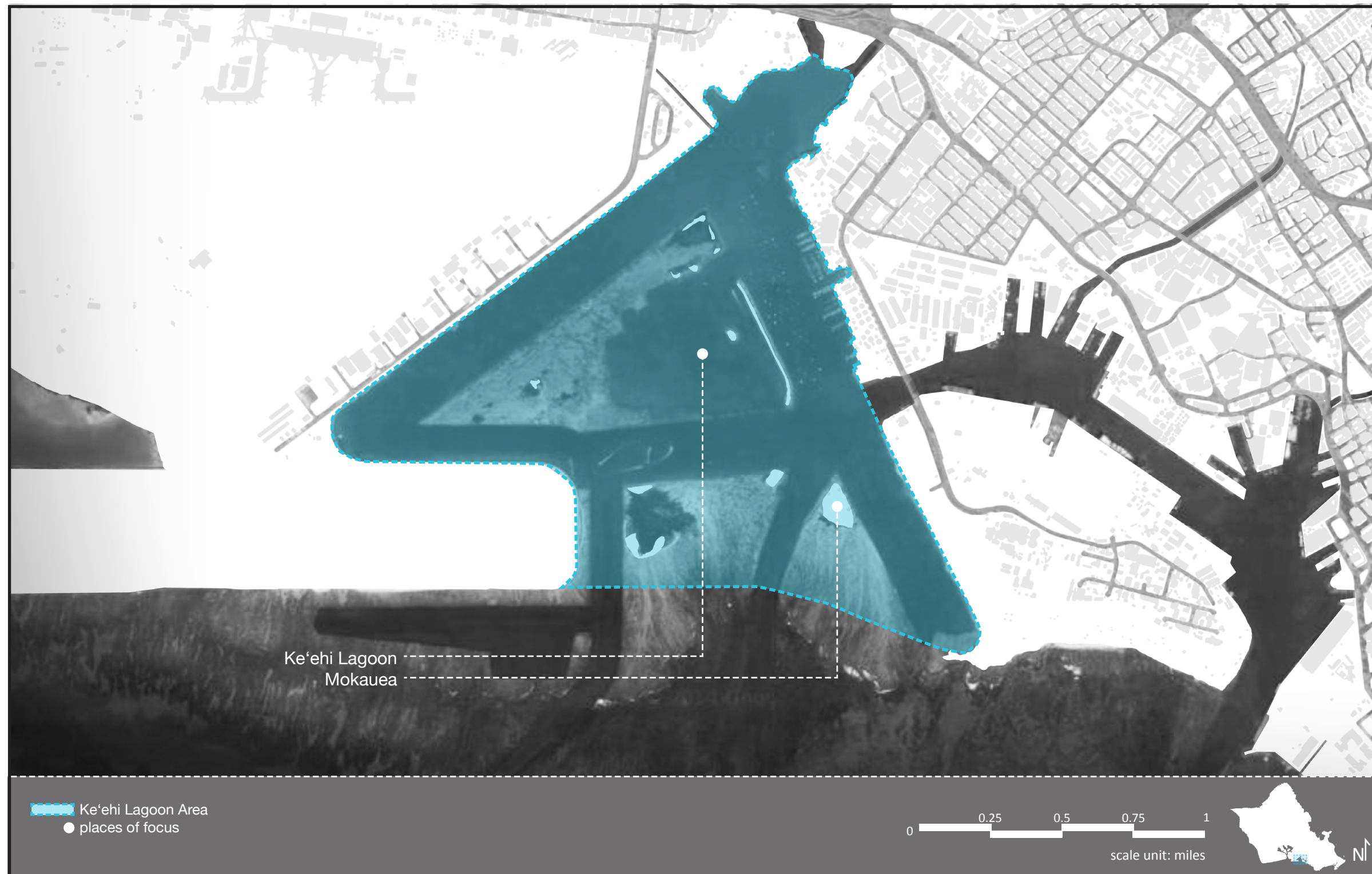
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<sup>31</sup> "Most Endangered Sites," Historic Hawaii Foundation, accessed December 18, 2014, <http://historichawaii.org/mes/>.



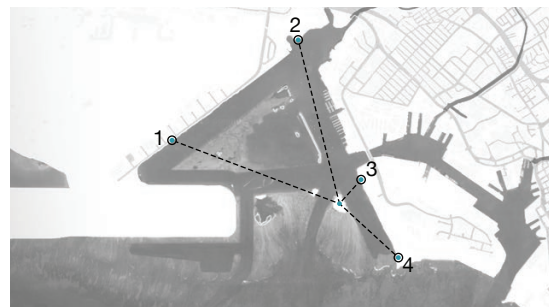
**Figure 11: Mokauea and Ke'ehi Lagoon and the Larger Contextual Area**  
[Data from HoLis, DPP, C&C of Honolulu, <http://gis.hicentral.com>, graphic by author]





**Figure 12: Mokauea and Ke'ehi Lagoon Existing Site Map**  
 [Data from HoLis, DPP, C&C of Honolulu, <http://gis.hicentral.com>, graphic by author]





Panoramic photographs taken from 4 areas along the Ke'ehi Lagoon Coastline (as indicated on left), focusing on the orientation and location of Mokauea

Mokauea

**Figure 13: Panoramic Photographs of the Ke'ehi Lagoon Area Taken from 4 Locations**  
[Images and graphic by author]



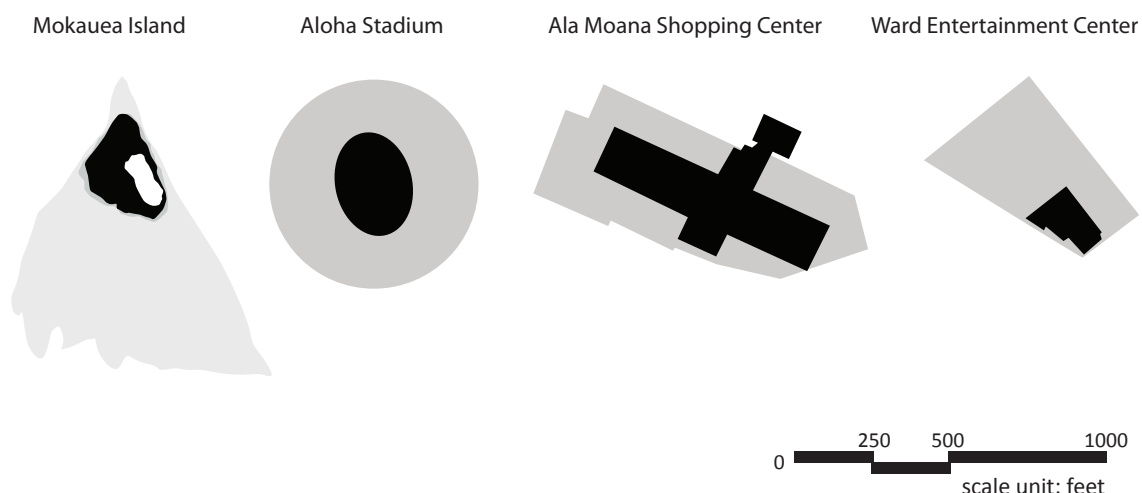


**Figure 14: Photograph of the Fishpond on Mokauea Island**  
[Image by author]



**Figure 15: Photograph of the Reef Flat on the Makai Shoreline of Mokauea Island**  
[Image by author]

## Size and Scale Comparison



**Figure 16: Size and Scale Comparison of Mokauea Island to Landmarks on Oahu**

[Graphic by author]

A tidal island located off the south shore of the Island of Oahu, and located within Ke‘ehi Lagoon, what is now Mokauea Island is situated in between Honolulu Harbor and The Honolulu International Airport. Although comprising a mere total of 10 acres, Mokauea Island serves as a reminder and plays a significant importance in the history and cultural identity of pre-contact Hawaii.<sup>32</sup> Mokauea is one of the remaining pieces of cultural history that is surviving through the modernization of Oahu. With a rich and complex history physically and socially, Mokauea also highlights and exemplifies the adaptive nature of Native Hawaiians. The Neighborhood fabric is constructed by both past and present functions evoking a specific community identity.

### CULTURAL SIGNIFICANCE

Mokauea’s importance lies in its establishment and continued usage (until recently) as a traditional self-sufficient Hawaiian fishing village, due to a functional fishpond, the ability to cultivate vegetables, medicinal plants and limu, and the abundance of reef fish in surrounding Ke‘ehi Lagoon.<sup>33</sup> More importantly, it is the last physical remembrance to the Mokauea Fishery as well as the 7 fisheries and salt beds encompassing the 41 fishponds in the Ke‘ehi area. The Ke‘ehi Lagoon area housed four tidal islands: Mokuoe‘o, Kahaka‘aulana, Maui Ola, and

<sup>32</sup> “Mokauea Island Restoration Project,” Kai Makana, accessed March 26, 2014, <http://www.kaimakana.org/mirp.htm>.

<sup>33</sup> “Hawaii Senate Bill 2485,” LegiScan, accessed April 18, 2014, <https://legiscan.com/HI/text/SB2485/id/464353>.

Mokauea.<sup>34</sup> Mokauea is the last of these islands to presently promote itself as a living fishing village, and is one of two remaining fishing villages in the entire state of Hawaii. The other, Miloli'i, is located on the Island of Hawaii.<sup>35</sup> The continuation of Mokauea Island as a remembrance of a fishing village is important to current residences, and the community at large for cultural significance, historical significance, and educational value of pre-contact Hawaiian traditions. Village communities such as Mokauea Island serve as a repository for a significant wealth of maritime skills and knowledge including: sea, currents, tidal motion, the building of canoes and fishing equipment, and the handling of fishing techniques.<sup>36</sup> Modernization has forced the decline of traditional skills and knowledge, propelling the loss of valuable cultural information.



**Figure 17: Historic Photographs of Mokauea**

[From left to right: Mokauea aerial view, Mokauea Fishermen, Residence on Mokauea, Images by Ed Greevy, <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1haw-Zz-1---10-about---00031-00110escapewin-00&a=d&cl=CL2.6&d=D431>, <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1en-Zz-1---10-about---00031-00110escapewin-00&a=d&c=edgreevy&cl=CL3.8&d=D184>, <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1haw-Zz-1---10-about---00031-00110escapewin-00&a=d&c=edgreevy&cl=CL6.7&d=D417>]

In pre-contact Hawaii, fishing and agriculture sustained the population and became a way of life as well as created a cultural identity. Hawaiians are recorded to have an intimate relationship with the land and sea, the ocean in particular being important to Native Hawaiians in terms of navigation, spirituality, culture, and beliefs.<sup>37</sup> This concept is beautifully explained by Kepā Maly in *Mālama Pono I Ka 'Āina- An Overview of the Hawaiian Cultural Landscape*.<sup>38</sup>

*In a traditional Hawaiian context, nature and culture are one and the same, there is no division between the two. The wealth and limitations of the land and ocean resources*

<sup>34</sup> "Mokauea Lives And Breathes," Mana, accessed April 17, 2014, <http://welivemana.com/articles/mokauea-lives-and-breathes>.

<sup>35</sup> Nathan Napoka, *Mokauea Island A Historical Study*, (Hawaii: Department of Land and Natural Resources, 1976), 1.

<sup>36</sup> "Hawaii Senate Bill 2485," LegiScan, accessed April 18, 2014, <https://legiscan.com/HI/text/SB2485/id/464353>.

<sup>37</sup> "Mālama Pono I Ka 'Āina-An Overview of the Hawaiian Cultural Landscape," Kumu Pono Associates LLC, accessed November 8, 2014, <http://www.kumupono.com/Hawaiian%20Cultural%20Landscape.pdf>.

<sup>38</sup> *Ibid.*



*gave birth to, and shaped the Hawaiian worldview. The ‘āina (land), wai (water), kai (ocean), and lewa (sky) were the foundation of life and the source of the spiritual relationship between people and their environs. Hawaiian mo‘olelo, or traditions express the attachment felt between the Hawaiian people and the earth around them. In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on, and around them, in the context of genealogical accounts. All forms of the natural environment—from the skies and mountain peaks, to the watered valleys and plains, to the shore line and ocean depths—were the embodiments of Hawaiian gods and deities.*<sup>39</sup>

Many Hawaiian traditions were derived from or were pertinent factors in the relationship to water and fishing. In traditional Hawaiian culture, the balance between nature, man, and the gods were necessary for pono or balance.<sup>40</sup> Native Hawaiians believe in laulima (cooperation), mālama (to respect or take care of), and kuleana (responsibility). This belief system guided everyday life and actions, creating ideals that are now important for the preservation and continuation of Mokauea Island, and is necessary in order to pass down knowledge, customs, and beliefs to future generations, Native and non-native.

## **HISTORY**

Mokauea was originally comprised of two tidal islands, generically called Mokauea North and Mokauea South.<sup>41</sup> There is debate whether the current physical location overlays the historic records of Mokauea Island. In Nathan Napoka’s research, he states that Mokauea today is an enlargement of Mokauea South due to dredging. Mokauea and the immediate surroundings, have been through a multitude of physical or geographical changes as well as political, social, cultural, and emotional. These changes will be discussed through a timeline of the Ke‘ehi Basin area. In addition, both the cultural and physical changes will be cited within the history of Mokauea Island, as both have shaped the Island we see today.

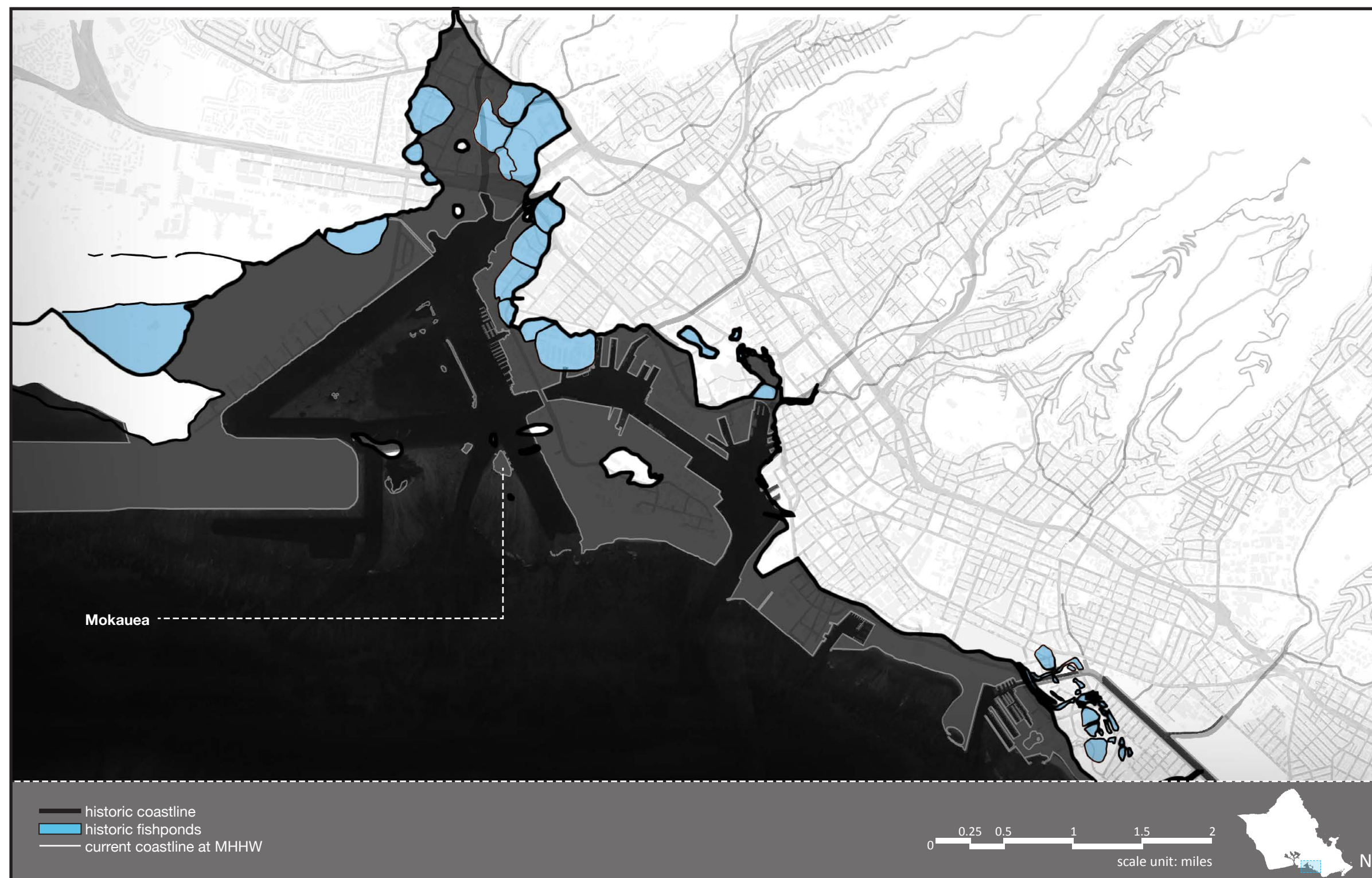
When comparative maps are overlaid, it is impossible to verify this data, as the accuracy of historic maps cannot be validated. For this design research project, the evidence of historical map data will be used and assumed to be accurate, and understood that no intention was used to insinuate falsification or embellishment. The addition of oral genealogical history will be used to corroborate and qualify data in further sections within this chapter.

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<sup>39</sup> *Ibid.*

<sup>40</sup> “Mālama Pono I Ka ‘Āina-An Overview of the Hawaiian Cultural Landscape,” Kumu Pono Associates LLC, accessed November 8, 2014, <http://www.kumupono.com/Hawaiian%20Cultural%20Landscape.pdf>.

<sup>41</sup> Nathan Napoka, *Mokauea Island A Historical Study* (Hawaii: Department of Land and Natural Resources, 1976), 2.

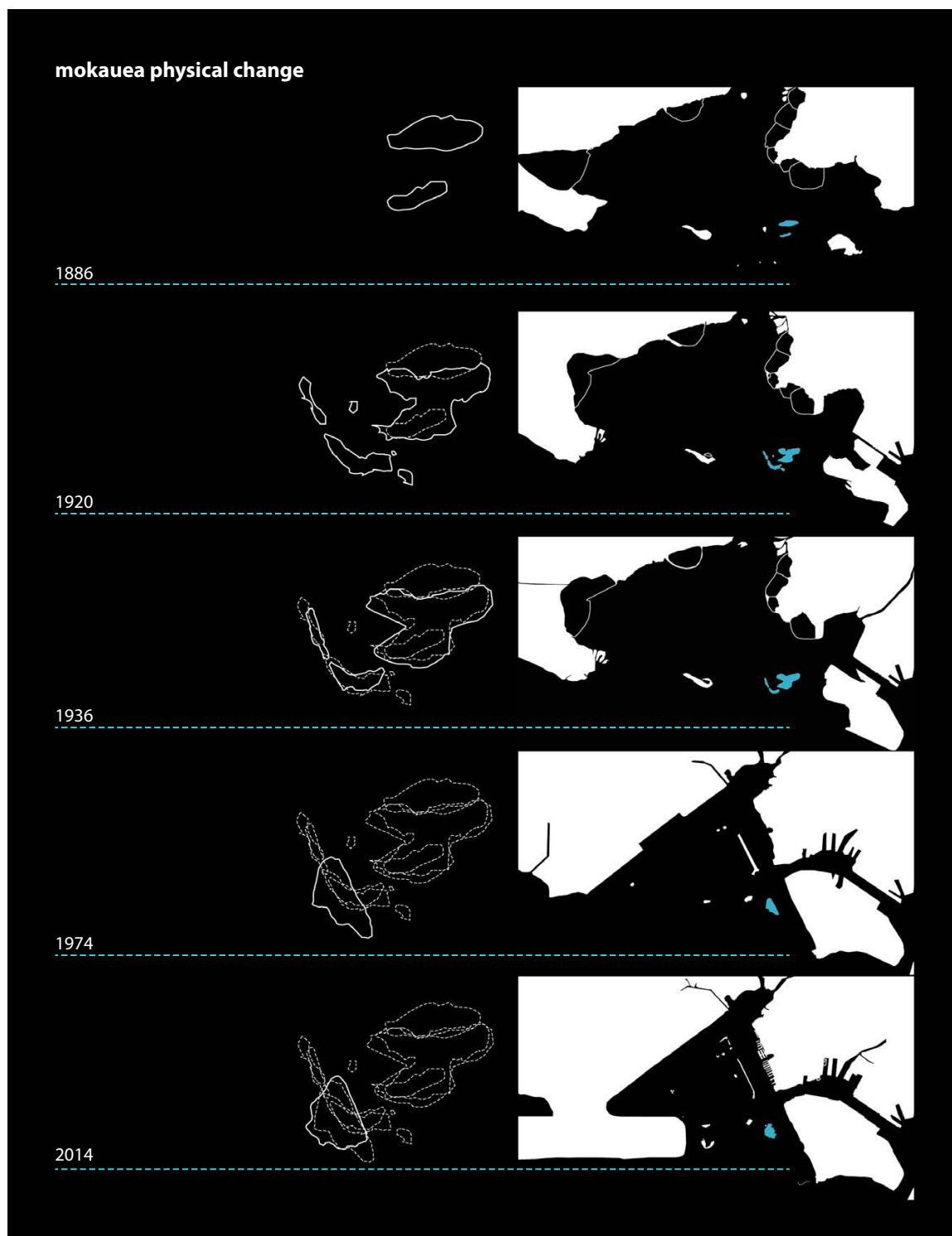


**Figure 18: Historic Fishponds Along the South Shore of Oahu**  
 [Data from historic maps as illustrated in Appendix B, graphic done by author]





**Figure 19: Physical Historical Change of Coastline on the South Shore of Oahu**  
 [Data from historic maps as illustrated in Appendix B, graphic done by author]



**Figure 20: Physical Historical Change of Mokauea Island**  
 [Data from historic maps as illustrated in Appendix B, graphic by author]

## History Pre-contact

Written recorded history of Mokauea spans as far back as a century and a half ago, although oral records date earlier. Native Hawaiians are a part of an oral culture where history is recorded from generation to generations through stories and/or chants. Although this method questions the accuracy of history, for the purpose of this research, we will assume oral recording in the preservation of history to be of fact.

According to State archaeologists Robert Hommon and Farley Watanabe, “the cultural value of Mokauea lies not in tangible structures but in its existence as a more or less traditional fishing community.”<sup>42</sup> According to the *OECD Glossary of Statistical Terms*, “A fishing community is a community that is substantially dependent on, or substantially engaged in, the harvest or processing of fishery resources to meet social and economic needs; the fishing vessel owners, operators, crew and fish processors that are based in such a community.”<sup>43</sup> In the Native Hawaiian worldview, a fishing community was an integral resource for sustenance relying on maritime knowledge and skill and dependent on an intimate relationship with ecosystems and nature.

The most prominent component of a fishing village was the extensive network of fishponds spanning the coastline. The Ke’ehi lagoon area, along with the adjacent Pearl Harbor area, was home to hundreds of fishponds. Native Hawaiians displayed their maritime skill through fishpond construction, fishing techniques, sea navigation, and canoe building. Parallel to oral culture, skills were passed down from generation to generation. The lack of an active fishing village threatens the prevalence of this knowledge bank.

Nathan Napoka, author of *Mokauea Island A Historical Study*, has compiled a document illustrating a historical account of the importance of Mokauea Island, and establishes a cultural and sociological importance.<sup>44</sup> Although written and published in 1976, much of his findings and research compilation will be used to highlight the significance of Mokauea Island up until that point in time.

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<sup>42</sup> Nathan Napoka, *Mokauea Island A Historical Study* (Hawaii: Department of Land and Natural Resources, 1976), 2-3.

<sup>43</sup> “Fishing Community,” *OECD Glossary of Statistical Terms*, accessed December 2, 2014, <https://stats.oecd.org/glossary/detail.asp?ID=993>.

<sup>44</sup> Nathan Napoka, *Mokauea Island A Historical Study* (Hawaii: Department of Land and Natural Resources, 1976).

**1700's:** There is a poem, mele (song), or chant in honor of the last semi-mythical chief Kualii who was reportedly born in 1550 and lived to 175 years old.<sup>45</sup> Originally written by Kumahukia and He'ea in the 1750's, the chant was handed down and preserved orally for more than 150 years. The 600-line chant recollects Kualii's life and accomplishments and includes a passage about Keehi Lagoon. The chant says, "He kai kà, anae ko Keehi" or a sea for scooping 'anae at Keehi. This chant is important in the documentation of the history of the area that must have been known for fishing, and therefore frequented and likely inhabited.

### **History Post-contact**

**1778:** The arrival of Captain Cook to the Hawaiian Islands marked a turning point for the Native Hawaiian population. Stemming from the end of the Hawaiian Government Kapu system, the Hawaiian population, for the most part, readily adopted a western point of view and related practices. Many of the traditional Hawaiian system was abandoned, and eventually lost, forgotten to a new culture.<sup>46</sup>

**1830:** In the 1830's King Kamehameha III declared the Ke'ehi are as royal fishponds under the protection of the Kingdom and Kapu system.<sup>47</sup>

**Mid to Late 1800's:** A story told by Muriel Lupenui in *Mokauea a Historical Study* summates the cultural and societal significance of Mokauea Island.<sup>48</sup> The story reflects about Mokauea Island during the time of immigrant arrival.

*Fishing Practices were quickly adopted by immigrants. Informant Muriel Lupenui reported that the fleet of Japanese fishermen who docked their sampans at Puuhale, used her fishing kuula (stone god). They made offerings to the god and many of them spoke fluent Hawaiian. They would also lease fish at her house if they had a successful day. On Kahaka'aulana was a house that the Linking family used as fishing quarters. They were Chinese restaurant owners who caught most of their fish in the Keehi Basin. After WWII the occupants of the Mokauea Fishery were multiracial. This reflected in the community that exists on*

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<sup>45</sup> Curtis J. Lyons, tr., introduction by W.D. Alexander, "The Song of Kualii, of Hawaii, Sandwich Islands," *The Journal of the Polynesian Society* volume 2 (1893):160-178, accessed June 12, 2014.

<sup>46</sup> Nathan Napoka, *Mokauea Island*, 9.

<sup>47</sup> Nathan Napoka, *Mokauea Island*, 5.

<sup>48</sup> Nathan Napoka, *Mokauea Island*, 16-17.

*Mokauea today. Occupants use adopted Hawaiian Fishing techniques and Hawaiian netting styles although a mixture of races now occupy the islands.*

This excerpt culminates the ideals of the Hawaiian culture and the ability to perpetuate harmony and sharing, helping to reinforce the idea that Hawaii is known as the melting pot of the Pacific. It also is a documentation of the use of Mokauea Island and Keehi Lagoon during the time of foreign immigration.

**1920's:** The Kalihi Channel was expanded to allow for larger commercial boats to pass through Honolulu Harbor. During the dredging, Sand Island and Quarantine Island were joined from dredged material dug from the Kalihi Channel.<sup>49</sup> The dredging destroyed the natural reef system in the area. Locals who were able to cross from Mokauea to the main island by foot were now forced to use a boat or swim. In an interview, Kehaulani Kupuhea explains that once the reef system was disconnected, “they couldn’t walk back home anymore during low tide. They couldn’t go unless they had a canoe or boat, and that is when things really changed.”<sup>50</sup>

**1940's:** During WWII there was an aggressive plan to build a seaplane runway within the Keehi Basin. Two 10-foot deep seaplane runways at 2-3 miles long, required the removal of over 17 million cubic yards of dredged material including coral reefs. The dredging completely wiped out one of the tidal islands Kahaka’aulana, almost completely destroyed Mokuoeo, and changed the shape of Mokauea Island.<sup>51</sup>

**1972-1975:** The Government issued plans for the building of Honolulu International’s reef runway extension. A total of 17 families resided on Mokauea Island and were asked to leave in order to build the extension. The residents refused to leave. Some residents were arrested for trespassing on what would be their home, and in June 1975, the State burned down 5 homes on Mokauea Island. There were many protests to save the Mokauea island as highlighted from newscasts and video production. Spurred on by the reaction to local media, and Nathan Napoka’s study on the historical value of Mokauea, the State decided to offer a 65-year contract lease with the residents in 1978.

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<sup>49</sup> “On the Reef,” Pacific Worlds, accessed June 2, 2014, <http://www.pacificworlds.com/nuuanu/sea/reef.cfm>.

<sup>50</sup> “Mokauea Lives And Breathes,” Mana, accessed April 17, 2014, <http://welivemana.com/articles/mokauea-lives-and-breathes>.

<sup>51</sup> Nathan Napoka, *Mokauea Island*, 15.

The stipulations were: buildings must be to code, and an educational program must be instated for local students to learn about fishing techniques, and the related.<sup>52</sup>

**1980:** Beginning in 1975, the Mokauea Fishermen's Association comprised of residents prompted an expansion of the fishpond on Mokauea. The US Army Corps of Engineers as well as Save the Surf Foundation helped to expand the pond including a new 'auwai (channel) and makaha (gate). Work was completed in 1980.<sup>53</sup>

**Following 30 years:** Highlighted through the history of Mokauea Island, the physical land formation has transformed over the years of development. Although the physical land was altered, the Native Hawaiian community of Mokauea Fishery adapted and persevered, allowing the continuance of traditional Native Hawaiian values, practices, and ways of life.

There is not a lot of information from 1980 to 2005. It is known that Mokauea Island continually faces many challenges including: Marine debris, invasive species, government involvement, and development plans in the area.<sup>54</sup> There have been many efforts in revitalizing Mokauea Island which will be discussed in a subsequent section. Mokauea has been witness to a turbulent history over ownership and occupancy rights as well as facing a modernizing society.

## **GOVERNING BODIES**

Ownership, management, and occupation information are necessary to determine governing bodies. The intentions of involved parties influence the development, maintenance, and future of Mokauea Island and the Ke'ehi Lagoon Community.

### **Ownership**

Currently, Mokauea is technically owned by the State of Hawaii. The Government seized the Island from Hawaiian Dredging Co. for proposed dredging of a seaplane runway on October 27, 1941.<sup>55</sup>

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<sup>52</sup> "Mokauea Island," Kainani, accessed June 2, 2014, <http://kainani.hpu.edu/cfung/mokouea-moreInfo.htm>.

<sup>53</sup> "Mokauea Island Restoration Project," Kai Makana, accessed March 26, 2014, <http://www.kaimakana.org/mirp.htm>.

<sup>54</sup> *Ibid.*

<sup>55</sup> D. S. Ingalls c/o U. S. Naval Air Station, *U.S. Naval Air Station, Honolulu, T. H. History*, 1945.





**Figure 21: Current Ownership and Land Management**  
 [Data from HoLis, DPP, City & County and Honolulu, <http://gis.hicentral.com>, graphic by author]

## Lease

In 1975, under the direction of Governor George Ariyoshi, the homes of the residents of Mokauea Island were to be burned down in an attempt of eviction. Through anecdotal stories of current residents, two residents willingly burned their own houses down claiming that if anyone were to destroy my house it will be me. Reaching local news and gaining support from local residents throughout Hawaii, protests caused the cease of eviction. Three years later, through the help of John Kelly, the Mokauea Fishermen's Association was formed and awarded a 65-year lease. Hawaii State General Lease No. 4582, stated that residents were granted a 65-year lease in accordance to educational demands and conformance of current building codes.<sup>56</sup> In this, the year 2015, more than half of the lease time has lapsed. 2043 is the date of termination unless renegotiations can be made to extend this lease period.

## Management

As expressed in the Hawaii Senate Bill 2485 and Hawaii House Bill 1675, and effective as of July 1, 2009, the Hawaii State Legislature:

*Authorizes DLNR to renegotiate leases with residents of Mokauea island to facilitate creation of an educational center where students, teachers, and other members of the public can learn the traditional methods used in a self sustaining Hawaiian fishing village. Establishes the Mokauea Island advisory committee.*<sup>57</sup>

The advisory committee consists of:

- *One member representing the department of land and natural resources, as designated by the chairperson of the board of land and natural resources;*
- *Two members of the Mokauea Fishing Village Association, as designated by the association;*
- *One member representing Kai Makana, as designated by the governor;*
- *One member of the Native Hawaiian Legal Corporation, as designated by the corporation; and*

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<sup>56</sup> "Hawaii Senate Bill 2485," LegiScan, accessed April 18, 2014, <https://legiscan.com/HI/text/SB2485/id/464353>.

<sup>57</sup> "S.B. NO. 2485, A Bill For an Act, Relating to Mokauea Island," The Senate Twenty-fifth Legislature, 2010, State of Hawaii, accessed June 6, 2014, <https://legiscan.com/HI/text/SB2485/id/464353/Hawaii-2010-SB2485-Introduced.html>.

- *One member of the board of trustees of the office of Hawaiian affairs, as designated by the board.*

### **Notice of Default**

December 5, 2008, the Hawaii State Department of Health issued a Notice of Apparent Violation regarding illegal discharge of wastewater at Mokauea Island. Residents along with Kai Makana, Group 70 International, Inc., Paradigm Construction, and Halau Ku Mana Public Charter School, worked together to develop and fund composting toilets and grey water discharge systems.<sup>58</sup> Today there is a composting toilet in every household, as well as 2 communal guest composting toilets. The exhaust system runs off of a solar or pv supported fan system. An underground grey water cesspool was designed and developed specifically for Mokauea Island.

In recent news, there has been a continuous and rather aggressive plan of rehabilitation, conservation, and perpetuation of Mokauea Island, in an effort to preserve the cultural history so that it may extend into the future.

### **EXISTING CONDITIONS**

#### **Affiliated organizations**

##### *Mokauea Fishermen's Association*

Led by Joni and Eleu Bagoood, and including residents of Mokauea Island, the aim of the non-profit Mokauea Fishermen's Association is to re-create a living example of a traditional Hawaiian subsistence fishing village, by preserving and protecting the island and introducing an educational program for local students to learn about traditional fishing and the reef environment.<sup>59</sup>

##### *Kai Makana*

Founded by Donna Kahiwaokawailani Kahakui, Kai Makana is a non-profit organization started in 1997. According to their website, "Kai Makana takes an active role in educating and mobilizing the public to better understand and preserve marine life and the ocean environment. Through educational youth mentorship and community-based programs, Kai Makana motivates people to protect, preserve, and respect the ocean as

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<sup>58</sup> "Request for Extension of Notice of Default," State of Hawaii Department of Land and Natural Resources, accessed April 20, 2014, <http://hawaii.gov/dlnr/chair/meeting/submittals/090424/D-Land-Submittals-D7.PDF>.

<sup>59</sup> "Mokauea Island Restoration Project," Kai Makana, accessed March 26, 2014, <http://www.kaimakana.org/mirp.htm>.

an ecosystem central to our health, wellness and happiness.”<sup>60</sup> They believe in an intergenerational, multi-cultural, and family oriented learning environment. Beginning in 2005, Kai Makana has continually put forth the effort environmentally and culturally to restore Mokauea Island as a living example of a traditional Hawaiian fishing village. Kai Makana has led the efforts in fishpond repair, marine debris removal, invasive species removal and native plant restoration, and historic canoe repair and halau construction.<sup>61</sup>

#### *Ho‘ola Mokauea*

Led by Kehaulani Kupihea, Ho‘ola Mokauea is a place based cultural education expressing the historical, cultural and natural resources of Keehi-Mokauea Island.<sup>62</sup> A flyer from Ho‘ola Mokauea states that they are “fortunate to mālama (take care of) Mokauea and sail in the wake of our ancestors by perpetuating the way of ka wa kahiko (the past).”

These non-profit organizations have played an important role in the revitalization of Mokauea Island. Together they host cleanup events and educational field trips for local schools, becoming the ambassadors for Mokauea Island.

#### **Current Educational Program**

Held almost every Saturday by Ho‘ola Mokauea, a cleanup and informational day is provided by Foundation President Kehaulani Kupihea and resident Joni Bagood. The excursion begins with a pule or prayer followed by a mele or chant. A short canoe ride to the island transitions visitors to a correct state of mind before sitting down to learn about the history and significance of Mokauea Island. Volunteer clean up focuses around eradication of long-thorned kiawe, clearing the walking path of invasive pickleweed, planting of native plants, and foreign rubbish collection. The trip ends with a walk out onto the reef flat and a return trip by canoe to Sand Island. These activities offer access to the island, creating awareness of the historical significance of Mokauea.

#### **Environmental and Biodiversity and Ecology**

Native plants on Mokauea include ‘aki‘aki, ‘akulikuli, pohinahina, naio, pohuehue, nena, pa‘u o hi‘iaka, ‘ohai, noni, ‘ahu‘awa, naupaka kahakai, and ko.<sup>63</sup> Invasive species fight for

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<sup>60</sup> “Mission, Vision & Values,” Kai Makana, accessed March 26, 2014, <http://www.kaimakana.org/mission.htm>.

<sup>61</sup> “Mokauea Island Restoration Project,” Kai Makana, accessed March 26, 2014, <http://www.kaimakana.org/mirp.htm>.

<sup>62</sup> “Ho‘ola Mokauea Island,” Facebook, accessed April 22, 2014, <https://www.facebook.com/HoolaMokaueaIsland>.

<sup>63</sup> Quitoriano, Jandi. “Visit to Mokauea Island.” Field trip excursion. Conducted by Ho‘ola Mokauea, Honolulu, multiple dates, 2014-2015.

resources and space threatening the existence of Native plants. Invasive species found on the island include pickleweed, long-thorn kiawe, and the red mangrove.

According to environmental surveys conducted by the Navy, the most common are the Moorish idol, reef triggerfish, Hawaiian dascyllus, and moray eel. Introduced fishes include the blue-spotted grouper, bluelined snapper, goatfishes, butterflyfishes, damselfishes, wrasses, parrotfishes, and surgeonfishes.<sup>64</sup> A historic chant on the History of Kualii reveals the abundance of anae or mulletfish in the mid 1700's.<sup>65</sup> The Navy environmental survey also revealed the presence of Cauliflower coral, although comprising less than 1% ground cover. Lobe coral and Finger coral were also observed in the area.<sup>66</sup>

The Ke'ehi Lagoon environment, biodiversity and ecology face constant pressure from industrialized areas including: The Honolulu International Airport, Sand Island Wastewater Treatment Plant, and Honolulu Harbor.

### **Existing Context**

The dichotomy of nature and developed industrial areas is prominent within the Ke'ehi Lagoon area, and the natural environment has been severely man-altered. The Honolulu International Airport and Reef Runway flank the western portion of Ke'ehi Lagoon, while Honolulu Harbor accommodates commercial shipping, commercial fishing, and passenger vessel activities, supplying 98.6% of all goods and products imported into the State.<sup>67</sup> The Sand Island Wastewater Treatment Plant is currently set for primary water treatment only. Although the release pipe is almost a mile out to sea, water quality is a concern for recreational uses.

### **Existing Function**

Ke'ehi Lagoon is outfitted with public access and is primarily used for maritime and coastal recreational activities. Literally a hidden gem, tucked away between large industrial communities, Mokauea and the entire Ke'ehi area reveals the intimate connection between nature and humans. Numerous site visits reveal the true essence of Mokauea, as jet skiers, canoe paddlers, and swimmers, exist harmoniously within the area.

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<sup>64</sup> "Marine Surveys," Commander U.S. Pacific Fleet, accessed January 30, 2015, [http://www.cpf.navy.mil/content/foia/ea/appendix\\_j.pdf](http://www.cpf.navy.mil/content/foia/ea/appendix_j.pdf).

<sup>65</sup> Nathan Napoka, *Mokauea Island*, 5.

<sup>66</sup> "Marine Surveys," Commander U.S. Pacific Fleet, accessed January 30, 2015, [http://www.cpf.navy.mil/content/foia/ea/appendix\\_j.pdf](http://www.cpf.navy.mil/content/foia/ea/appendix_j.pdf).

<sup>67</sup> "Honolulu Harbor," City and County of Honolulu, accessed February 12, 2014, <http://www1.honolulu.gov/refs/nco/nb15/12/15marmin.htm>.

A survey was conducted on the Northwestern portion of Sand Island State park in order to understand the user community. Survey questionnaires as illustrated in Appendix C were randomly distributed to willing participants. The following is a summary of the survey results:<sup>68</sup>

Majority of participants were local residents. Only one participant was a visitor to Hawaii. Of all visitors, the frequency of the area was split between being their first time and visiting regularly at least once a week. Within the local residents group, there was a mixture of reasons why they were at this location ranging from: canoe paddling, attending a picnic, to fishing. Upon observation of the area, there were also people who were kayaking, jet skiing, swimming, and eating lunch. There was also a Duck Tour vehicle in the parking lot. The activities within this area are closely related to the maritime environment and should not be disturbed within a new design intervention.

Most of the participants have not been to Mokauea or participated in conservation efforts on Mokauea. This provides an opportunity to integrate the Water Network Experience to enhance the area with cultural and historical inclusion. In terms of new development, participant responses included a mixture of: snack bar, restaurant, farmers' market, canoe storage, and bigger park area. These services will attempt to be addressed within the design solution.

The most encouraging information gathered from the surveys is that all participants felt that this was a safe area. The Water Network Experience will be a welcome addition to the Ke'ehi Lagoon community, being accessible to all members of society.

### **Existing Residents**

Mokauea is currently the privatized home of four families and residences, living cohesively as a community. Many of the residents have historical ties to the island or the area. Resident Joni Bagood is the leader of conservation and preservation efforts, and can be seen on her deck waving hello to passersby, exuding the aloha, or warmth of spirit. Numerous site visits to Mokauea helped to build a lasting relationship with Auntie Joni. A formal interview was held through email correspondence, and the following interview summary is included to elucidate the meaning of Mokauea to residents.<sup>69</sup>

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<sup>68</sup> Quitoriano, Jandi. "Visitor Information." Survey. February 28, 2015. Sample available in Appendix C.

<sup>69</sup> Joni Bagood (resident of Mokauea) Interview by Jandi Quitoriano. March 19, 2015. Sample available in Appendix C.

Joni Bagood is caretaker and resident of Mokauea Island, living there for approximately 15 years, her father and grandmother also living on Mokauea in the 70's. She represents one of 23 families included in the lease agreement issued by the Department of Land and Natural Resources, and as there are no plans for a lease extension, instead, she is hopeful for status as a preserved historical site.

In regard to conservation efforts on Mokauea, Aunty Joni believes that publicity helps to preserve "the significant cultural history which is so important to be shared to all who visit Mokauea." She views Mokauea as an outdoor classroom with canoe transportation as an added experience, and mentions that she would like to see a museum built on the island to house the historic canoe that was recently found. Interpreted as sentiment.

In line with Native Hawaiian practices, residents live sustainably and respectfully with their environment including: planting of Native plant species, asking boaters to control their wake, sand bagging eroded areas, educating the public about invasive species control, recycling of materials and water, and the use of composting toilets.

In regards to future development and the future of Mokauea, Aunty Joni would appreciate a museum or education center and an information center, along with water desalinization, solar and wind harvesting, and a better functioning fishpond.

The interview provides a glimpse into the lifestyle provided by Mokauea Island, and highlights the significance of the importance to continue the essence of Mokauea. The interview in itself is interpreted as sentiment. Through another's eyes, you can feel the intangible qualities that Mokauea provides and represents. It is also evident that Aunty Joni and other residents want and continue to share Mokauea with everyone. At the end of the interview, Aunty Joni summarizes her feelings:

*We really need to have Mokauea become a preserved historical site because of the unique cultural significance of the whole Ke'ehi. If not, we'll be losing a treasured piece of old Hawa'i.*<sup>70</sup>

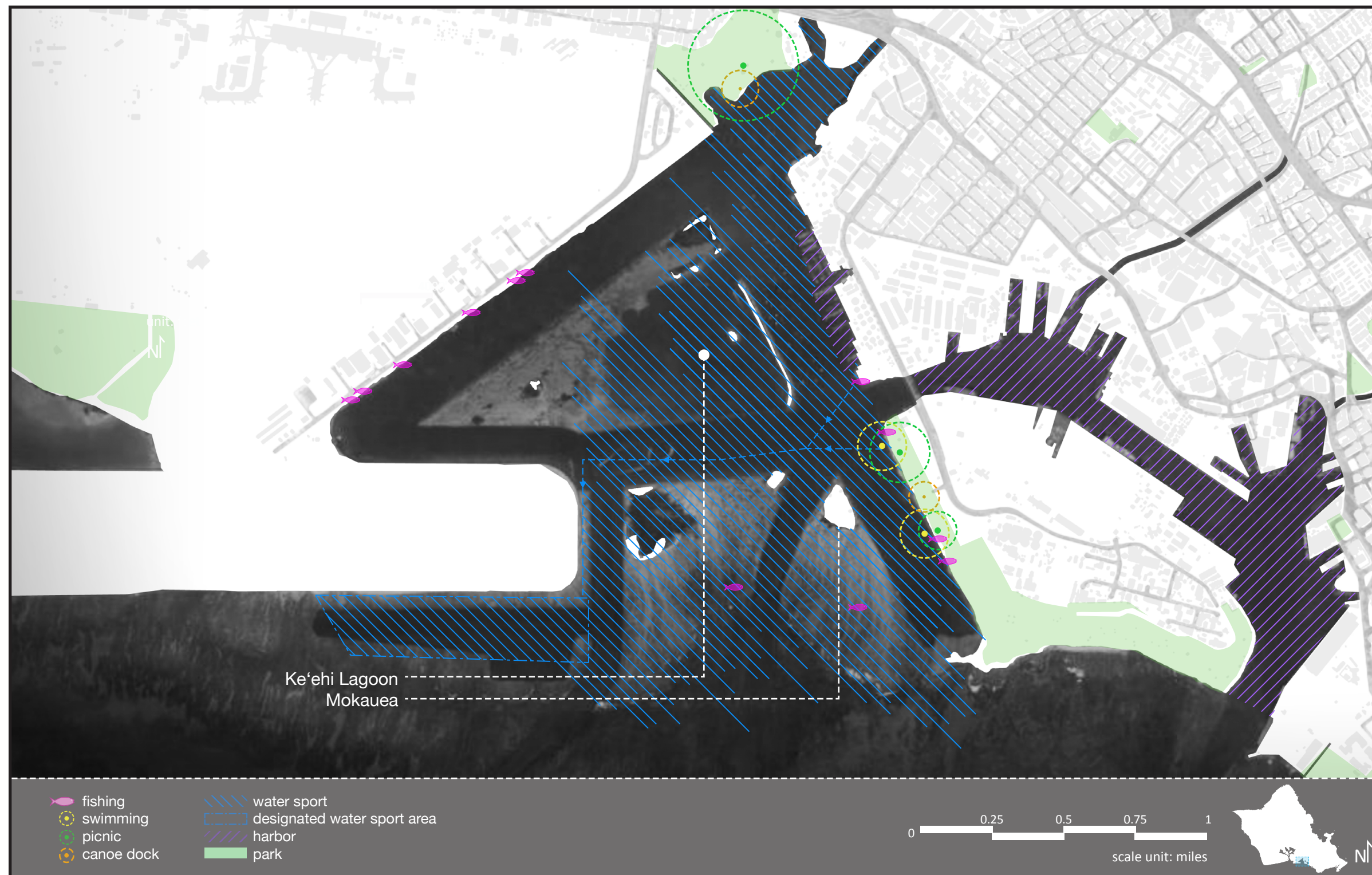
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<sup>70</sup> Joni Bagood (resident of Mokauea) Interview by Jandi Quitoriano. March 19, 2015. Sample available in Appendix C.









**Figure 24: Existing Function Map for Entire Ke'ehi Lagoon Area**  
 [Image from Google Maps, graphic by author]

## **Existing Architecture**

Current house structures are set on piers or stilts to accommodate for tidal change and protection from ocean waters. Infrastructure is limited on the island. In the pre-mentioned section, black water is processed through composting toilets, and the nutrient rich mulch is used to fertilize the plants on the island. Power or electricity, is provided by individual generators, and a newly installed potable water supply is available through an underwater pipe system stemming from Sand Island. Residents use as much rainwater catchment as possible to reduce dependency on the potable water supply. The Island is in need of an energy supply (generators are presently being used), a fresh water source, a wastewater treatment facility, and facilities for continued education programs.<sup>71</sup>

The future of Mokauea Island will be amidst a multitude of developmental plans surrounding the islands and it will be pertinent to design in accordance with the cultural nature and history of the area as well as accommodate for planned and future functions.

## **Existing Plans**

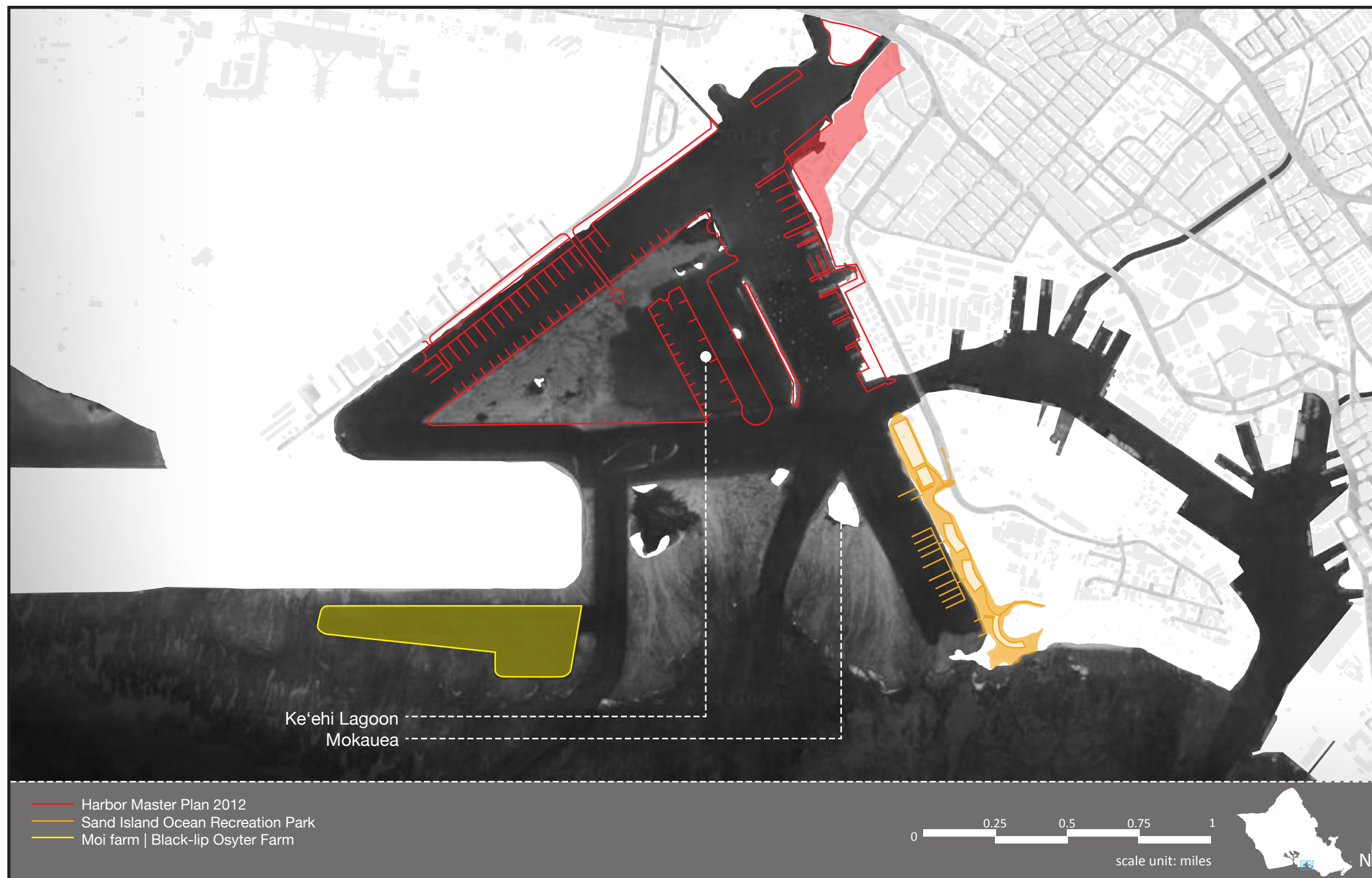
Ke'ehi Lagoon is sandwiched between highly developed and industrialized areas, including a major highway system. The natural beauty of Ke'ehi Lagoon has been somehow and miraculously preserved despite constant pressure from increased development. There are existing plans for development on or near Ke'ehi lagoon that threatens existing functions and the essence of Mokauea.

Proposed plans for Mokauea and surrounding Ke'ehi Lagoon include:

- Marina Plan
- Sand Island Recreational Park
- Matson Overflow
- Moi Fishery
- Black-lip Pearl Oyster Farm

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<sup>71</sup> Joni Bagood (resident of Mokauea) Interview by Jandi Quitoriano. March 19, 2015. Sample available in Appendix C.



**Figure 25: Existing Plans for Mokauea and Surrounding Ke'ehi Lagoon**

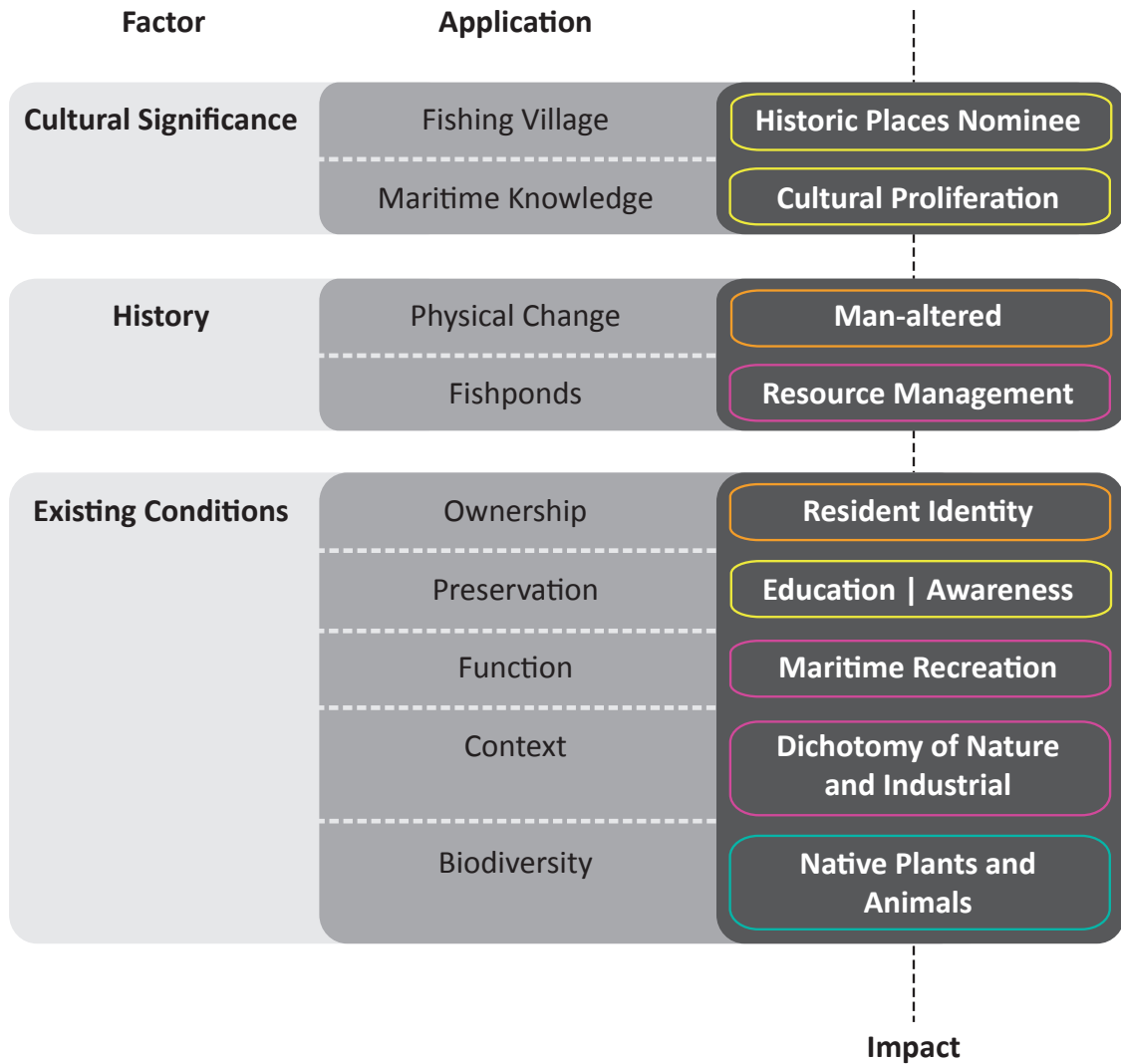
[Data from HiDOT, <http://hidot.hawaii.gov/harbors/files/2013/01/Oahu-2020-Master-Plan.pdf> DLNR, [http://lrbhawaii.info/reports/legprts/dlnr/2013/hcr181\\_hd1\\_13.pdf](http://lrbhawaii.info/reports/legprts/dlnr/2013/hcr181_hd1_13.pdf), <http://dlnr.hawaii.gov/occl/files/2013/08/3719-Mamala-Bay-Mariculture-FEA.pdf>, [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf), graphic by author]

## **CONCLUSION**

There is evidence to warrant the preservation and perpetuation of Mokauea based on its symbolic representation as a physical reminder of historical and cultural history. The existing Island of Mokauea and larger Ke'ehi Lagoon community is a mixture of recreational, industrial, and residential spaces. A large reef flat physically extends the boundaries of the coastline, blurring the lines of land and ocean. New design intervention implementation should celebrate the history of Mokauea and Ke'ehi Lagoon, accommodate for existing functions, and prepare and assimilate with sea-level rise.

# COMMUNITY

[mokauea + ke'ehi lagoon]



note: color-coding will be aid in organizational structure as illustrated in Chapter 6.

**Figure 26: Conclusion Diagram for Community**  
[Graphic by author]

## CHAPTER 3. CLIMATE CHANGE [SCIENTIFIC PERSPECTIVE]

The word place, as in sense of place, refers to the physical or tangible matter relating to a culture and community. As discussed in the previous chapter, Mokauea is a tidal island located within a Lagoon, and is physically prone to the negative effects of climate change.

There are many who doubt the existence of climate change and are unable to understand the reality of sea-level rise. Climate change presents as a slow process, but will inevitably result in unprecedented and extreme weather phenomena including sea-level rise. Understanding the components of climate change, including drivers and effects will help set a foundation to the implication and need of adaptation strategies when designing for coastal locations and habitats. The natural environment is the final component of sense of place, setting the physical platform and arena.

### CLIMATE

To understand climate change, the definition of climate and the components of the climate system must first be identified, defined, and explained.

While the general definition of climate includes weather conditions, there is a distinctive difference between the two terms. Weather is an instantaneous atmospheric condition caused by the fluctuating state of the atmosphere around us, and is characterized by air and water temperature, wind speed, precipitation, and other elements.<sup>72</sup> Weather is used to define the short-term state of atmospheric conditions of a specific geographical location, while climate is used to define long-term averages of weather patterns in a larger region. The World Meteorological Organization suggests a 30-year standard time span, in order to determine or define climate of a region, and is dependent on latitude, distance to sea, vegetation, presence or absence of mountains, and other geographical factors.<sup>73</sup> Climate is therefore an expectation or projection based on historical patterns, and weather is the responsive phenomenon.

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<sup>72</sup> Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), *IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), 1535 pp, doi:10.1017/CB09781107415324.

<sup>73</sup> "Basics of Climate Change," Know, accessed September 17 2014, [http://know.climateofconcern.org/index.php?option=com\\_content&task=article&id=115](http://know.climateofconcern.org/index.php?option=com_content&task=article&id=115).



## CLIMATE SYSTEM

Earth's climate is a complex system of components, working together, creating a habitable environment. Earth's climate system includes: the atmosphere, the hydrosphere (oceans, lakes and rivers), the cryosphere (snow and ice), the geosphere (solids and rocks) or lithosphere (land content), and the biosphere (living organisms).<sup>74</sup> Each component has a specific responsibility, contributing to an interactive system.

The following explanations and definitions are provided by *A Student's Guide To Global Climate Change* provided by the Environmental Protection Agency, and *The Basics of Climate Change* provided by Know Climate Change.<sup>75 76</sup>

- **Atmosphere**

*Earth's atmosphere is comprised of an envelope of gases (nitrogen, oxygen, inert gases and carbon dioxide) that surrounds Earth's surface. The atmosphere is divided into 5 layer: the troposphere, the stratosphere, the mesosphere, the thermosphere, and the exosphere, and extends upwards for several hundred kilometers. The atmosphere is home to weather, is responsible for solar radiation and meteor collision protection, and is constantly moving, transporting heat, cold, moisture, and clouds over surface. It is the most unstable or rapidly changing part of the system.*

- **Biosphere**

*Earth's biosphere is the summation of all global ecosystems, integrating all living beings including the relationships to other components of the climate system. This includes but is not limited to: soils, forests, coral reefs, and humanity. The biosphere is an important source and sink of greenhouse gases including carbon dioxide, water vapor, and methane. Also known as the zone of life in Earth.*

- **Cryosphere**

*The Earth's cryosphere is comprised of five subsets including: ice caps, polar sea-ice, permafrost, mountain glaciers, and seasonal snow cover. The cryosphere's importance*

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<sup>74</sup> "Climate Change Science Overview," United States Environmental Protection Agency, accessed September 20, 2014, <http://www.epa.gov/climatechange/science/overview.html>.

<sup>75</sup> "Climate Concepts," United States Environmental Protection Agency, accessed September 20, 2014, <http://www.epa.gov/climatechange/students/basics/concepts.html>.

<sup>76</sup> "Basics of Climate Change," Know, accessed September 17 2014, [http://know.climateofconcern.org/index.php?option=com\\_content&task=article&id=115](http://know.climateofconcern.org/index.php?option=com_content&task=article&id=115).

*lies in its absorbing and reflective properties of solar radiation, low thermal conductivity, large thermal inertia, trapping of greenhouse gases, water storage, driving deep ocean water circulation, and is a strong determinant in sea-level change.*

- **Geosphere / lithosphere**

*The Earth's geosphere or lithosphere is comprised of the land content of Earth, encompassing the rigid outermost shell of the planet. The geosphere or lithosphere is responsible for the absorption of solar radiation, acts as a carbon sink, and influences atmospheric conditions through texture of the land.*

- **Hydrosphere**

*The Earth's hydrosphere is comprised of all liquid surfaces and subterranean waters including fresh and saline waters, run-off and storage. Oceans comprise nearly 70% of Earth's surface, and are able to store and transport energy, and store large amounts of carbon dioxide. Heat capacity allows for the restriction of drastic temperature changes and thus functions as a regulator of the Earth's climate. Circulation of water driven by wind, contrasts in density caused by salinity, and thermal gradients are comprise thermo-haline circulation. Vertical heat energy exchange between upper and lower layers are important for climate stability, as extremes cause a heat source or heat sink. As warmer water expands, sea level rises.*

As stated earlier, each component operates within a system creating climatic conditions. Examples of these interactions are as follows:<sup>77</sup>

- **Atmosphere-hydrosphere**

*The atmosphere and the oceans are strongly coupled through the hydrological cycle, exchanging water vapor and heat through evaporation, influencing salinity, distribution, and the thermo-haline circulation. The atmosphere and ocean also exchange carbon dioxide in an act to maintain a balance.*

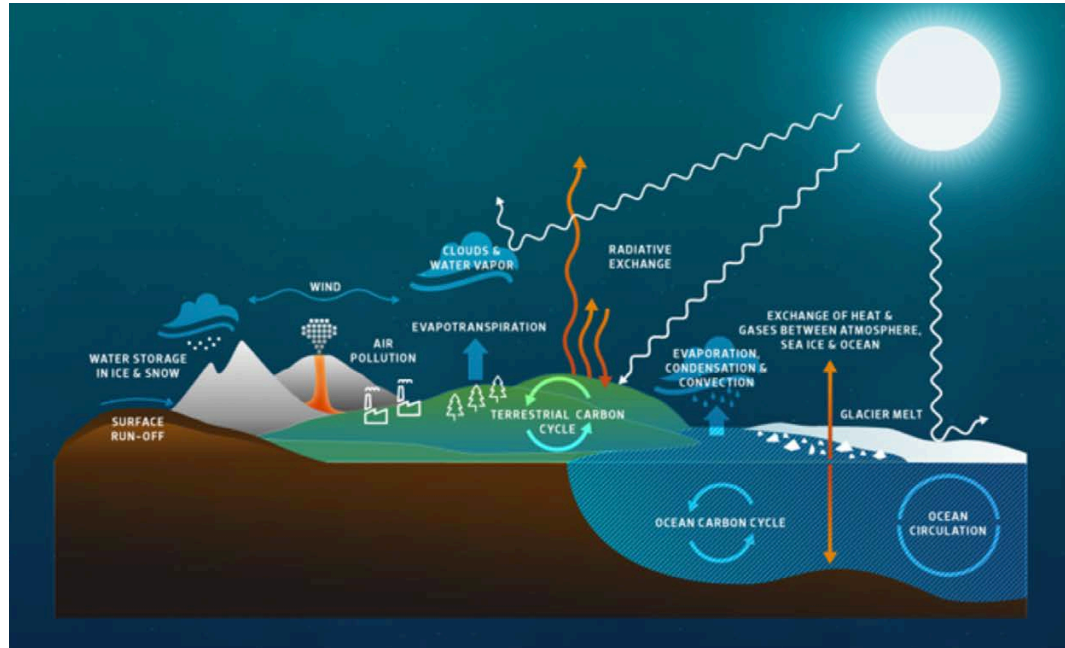
- **Lithosphere-atmosphere**

*Volcanic activity releases various gases including carbon dioxide and dust particles into the atmosphere affecting solar radiation penetration.*

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<sup>77</sup> "Basics of Climate Change," Know, accessed September 17 2014, [http://know.climateofconcern.org/index.php?option=com\\_content&task=article&id=119](http://know.climateofconcern.org/index.php?option=com_content&task=article&id=119).





**Figure 27: Interactions within Climate System**

[Image from the EPA, <http://epa.gov/climatechange/science/future.html>]

- **Cryosphere-hydrosphere**

*Mountain ice caps are the major source of water for rivers. Increased melting of ice caps can lead to rise in river water levels causing floods and uneven distribution as a future water resource.*

- **Biosphere-atmosphere**

*The biosphere affects the input of water in the atmosphere through evaporation and transpiration. It also helps in atmosphere's radiative balance through the amount of sunlight reflected back to the sky. In addition, human activities release various harmful gases, trapping solar radiation and causing global warming. Plants attempt to oppose global warming by absorbing carbon dioxide through photosynthesis.*

- **Lithosphere-biosphere**

*Vegetation cover on the soil prevents its erosion as the roots hold the soil in place. A decrease in the green areas leads to increased soil erosion.*

It is important to understand that effects to one component of the system alternatively affect other components of the system. Earth's climate system is dynamic, and in a constant strive for balance.

## CLIMATE CHANGE

As defined by the Intergovernmental Panel on Climate Change (IPCC), “Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.”<sup>78</sup> This definition clearly underscores the reliance on quantifiable data in determining the reasoning, effects, and projections of climate change.

Natural phenomena due to influxes in any one or a combination of the different components of the climate system, causes a shift in climate, or a climate change. The ice age is an example of this natural occurrence. There is debate among scholars, scientist and the general public on the reason for climate change and the projected effects. However, the Framework Convention on Climate Change (UNFCCC) defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”<sup>79</sup> The distinction of human intervention within the framework of climate change points to an anthropogenic cause leading to the idea of the anthropocene.

### Anthropocene

The Holocene, translated as recent whole, is the official current epoch beginning from the last major glacial epoch or ice age approximately 11,700 years ago. It represents the most interglacial interval of the Quaternary period, and forms the chronological framework for human history, coinciding with the late and post-stone age history of mankind. Although homo sapiens pre date the Holocene epoch, the Holocene has recorded all of humanity’s recorded history, including its activities and consequences to the environment.<sup>80</sup> There are some in the scientific community who believe that the impacts to the environment caused by man signify a new epoch.

Proposed by Eugene F. Stoermer in the 1980’s and popularized over a decade ago by Nobel Prize winner Paul Crutzen, The Anthropocene is the title suggested for a new geological epoch that documents the influence of human behavioral impact on Earth. From the 1800’s scientists were aware of the effect of man on the environment. In an article entitled *The*

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<sup>78</sup> Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.), *Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007* (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA).

<sup>79</sup> “Glossary of Climate Change Acronyms,” United Nations Framework Convention on Climate Change, accessed January 8, 2014, [http://unfccc.int/files/documentation/text/html/list\\_search.php?what=&val=&valan=a&anf=0&id=10](http://unfccc.int/files/documentation/text/html/list_search.php?what=&val=&valan=a&anf=0&id=10).

<sup>80</sup> “The Holocene Epoch,” University of California Museum of Paleontology, accessed January 10, 2015, <http://www.ucmp.berkeley.edu/quaternary/holocene.php>.

*Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature*, Crutzen details the history of the development of the anthropocene as follows:<sup>81</sup>

- 1873: Italian geologist Antonio Stoppani “new telluric force in which power and universality may be compared to the greater forces of earth.”
- 1926: V.I. Vernadsky “The direction in which the processes of evolution must proceed, namely towards increasing consciousness and thought, and forms having greater and great influence on their surroundings.”
- Teilhard de Chardin and Vernadsky used the term *noosphere* world of thought to mark the growing role of human brainpower in shaping its won future and environment.

Epochs are determined by geological indicators including tree rings, carbon dating, and are able to be quantified, and dated. The anthropocene is argued to have a start date as recent as the industrial revolution of the late 18<sup>th</sup> century, and as far back as the Neolithic revolution. Regardless of a specific point in time, humans and their actions are intruding on the natural climate system causing unprecedented climate change. Documentation, analysis, and the synthesis of data have been an important value in determining causes, impacts, and future projections of anthropogenic action on the climate system.

The IPCC recently announced their Fifth Assessment Report (AR5) providing current scientific knowledge relevant to climate change. The report is sectioned into three Working Group categories including: Working Group I, Working Group II and Working Group III.<sup>82</sup>

Information borrowed from the IPCC Working Group I AR5 Summary for Policy Makers will be used to document scientific or quantifiable evidence of anthropogenic related climate change from the mid 1700’s to present, and projected data where available, through a scientific approach.<sup>83</sup>

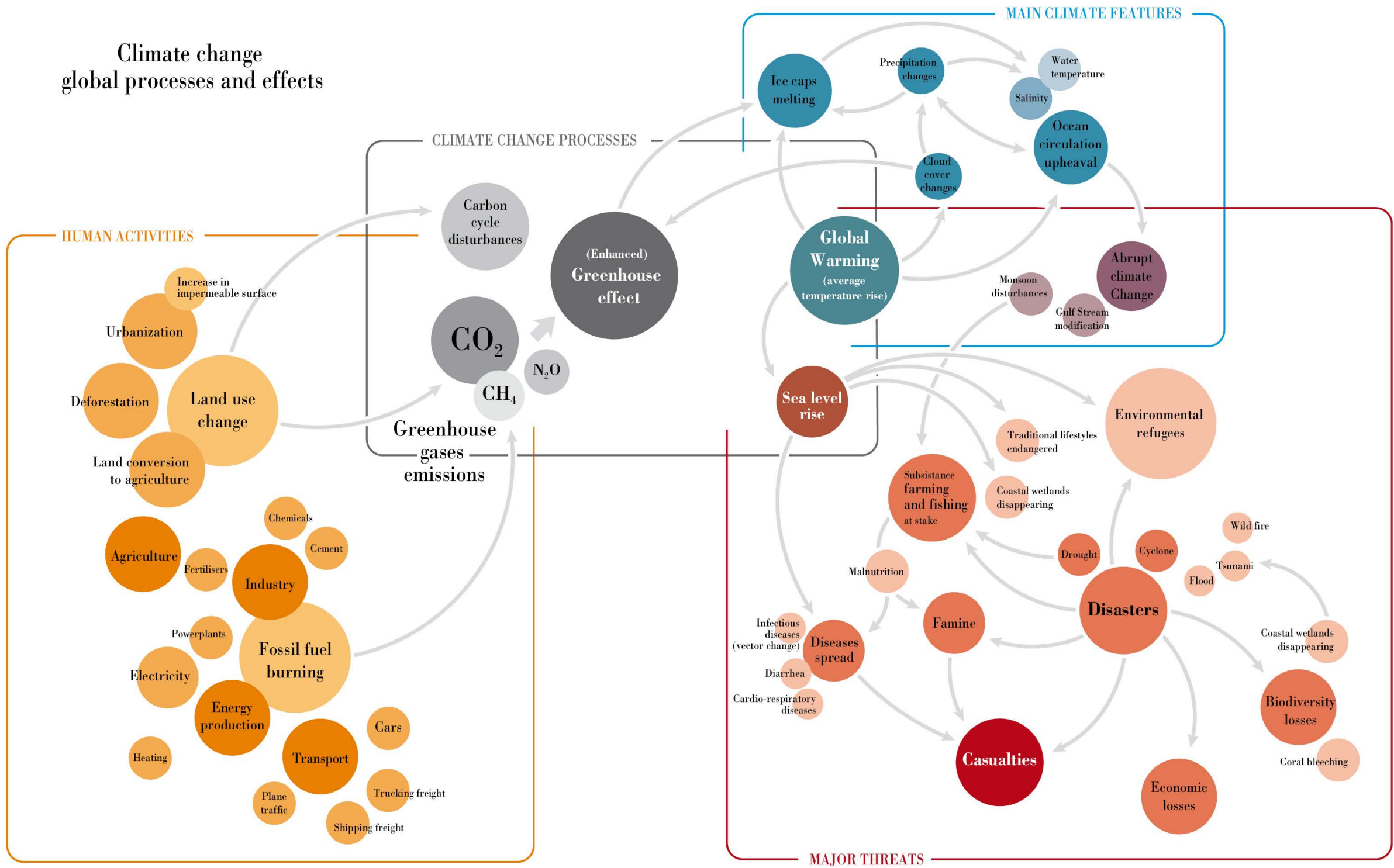
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<sup>81</sup> Will Steffen, Paul J. Crutzen, John R. McNeill, “The Anthropocene: Are Humans Now Overwhelming the Forces of Nature,” *Ambio: A Journal of the Human Environment* 36(8):614-621 (2007), accessed January 8, 2015, doi: [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[614:TAAHNO\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[614:TAAHNO]2.0.CO;2).

<sup>82</sup> Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.), *IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA), 1535 pp, doi:10.1017/CB09781107415324.

<sup>83</sup> *Ibid.*

Climate change  
global processes and effects



**Figure 28: Global Climate Change Causes and Effects**  
[Data and graphic from *Kick the Habit: A UN Guide to Climate Neutrality*, <http://maps.grida.no/go/graphic/climate-change-global-processes-and-effects1>]

## Scientific Evidence of Climate Change

[Provided by the IPCC Working Group I AR5 Summary for Policy Makers<sup>84</sup>]

Changes to the Global environment have caused a dramatic reaction within our climate system. According to the IPCC AR5, the atmospheric concentrations of carbon dioxide, methane, and nitrous oxide gases have reached unprecedented levels in at least the last 800,000 years. Carbon dioxide concentrations alone, have increased by 40% since pre-industrial times, primarily from fossil fuel emissions and secondarily from net land use change emissions. Almost the entire globe has experienced surface warming, averaging a combined land and surface temperature warming of .85 degrees Celsius from 1880 to 2012.

Global Warming is also the cause of the Greenland and Antarctic ice sheets losing mass, causing a shift in climatic patterns. The IPCC states that since 1970's glacier mass loss and ocean thermal expansion from warming comprise 75% of observed global mean sea level rise. The rate of sea-level rise since the mid 19<sup>th</sup> century has been larger than the mean rate during the last previous 2 millennia. In addition to sea-level rise, Earth's oceans have absorbed about 30% of the emitted anthropogenic carbon dioxide, causing ocean acidification and an increase in salinity.

These changes are noted in the effects to current global ecosystems including coral bleaching, heat waves, a change in seasonal patterns, coastal erosion, water inundation, and reduced agricultural yields to name a few.<sup>85</sup> Increases in the negative effects of climate change will continue to rise for decades and are now being projected to inform mitigation and adaptation strategies. Figure 29 illustrates the projected effects of climate change based on RCP or Representative Concentration Pathways. The RCPs comprise four greenhouse gas concentration trajectories adopted by the IPCC to demonstrate a range of scenarios. RCP 2.6 is the lowest value, and RCP 8.5 is the highest value and therefore represents the most severe impact.

The most recent IPCC report includes sea level rise projections that estimate a global sea level rise of up to 98 cm (or a little over three feet) by 2100 under the RCP 8.5 (business as usual) scenario.<sup>86</sup> Various sources state that sea level rise was the most controversial issue in

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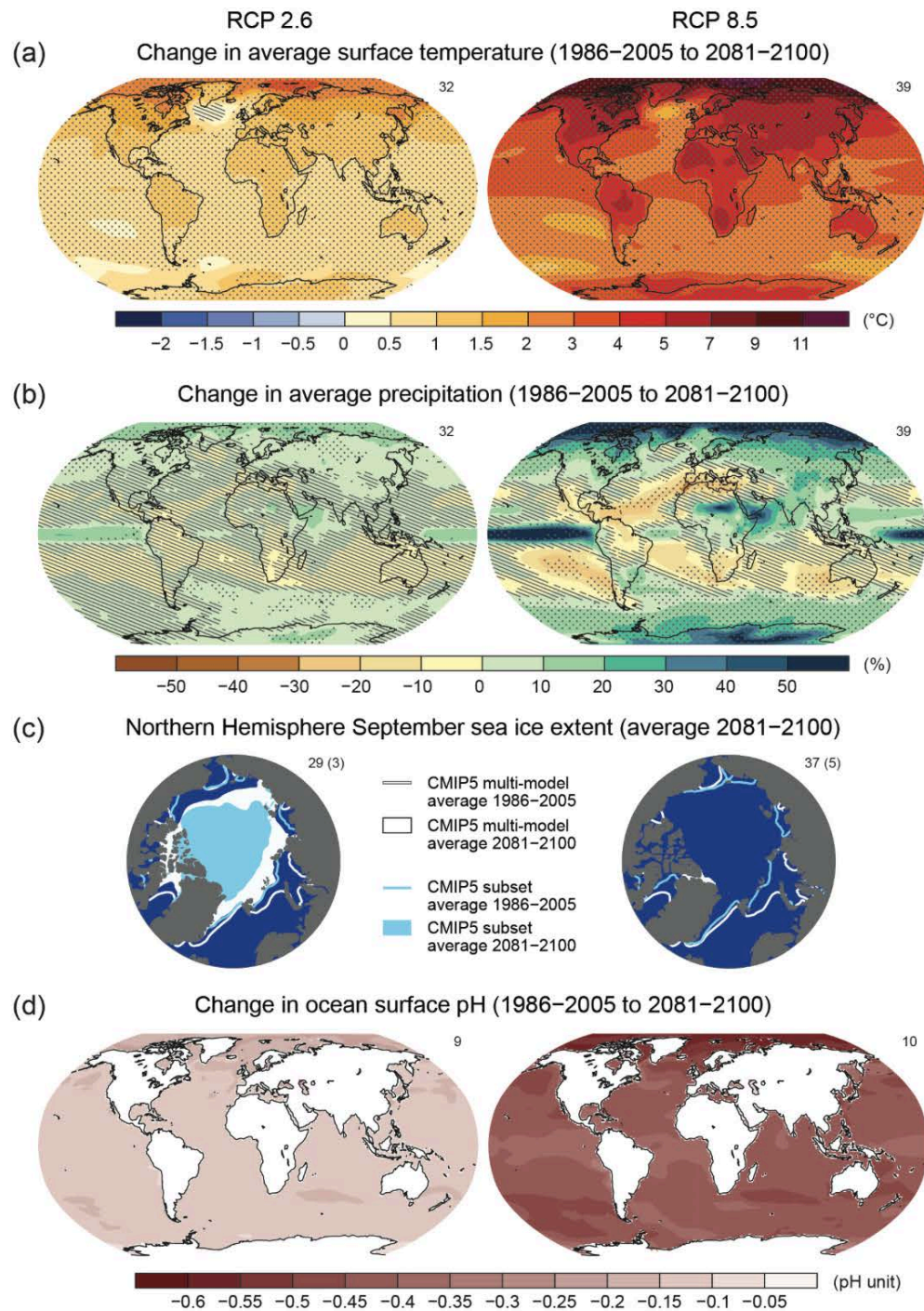
<sup>84</sup> Stocker et al., *IPCC AR5 Working Group I*.

<sup>85</sup> "The Current and Future Consequences of Global Change," NASA, accessed January 12, 2015, <http://climate.nasa.gov/effects/>.

<sup>86</sup> Stocker et al., *IPCC AR5 Working Group I*.

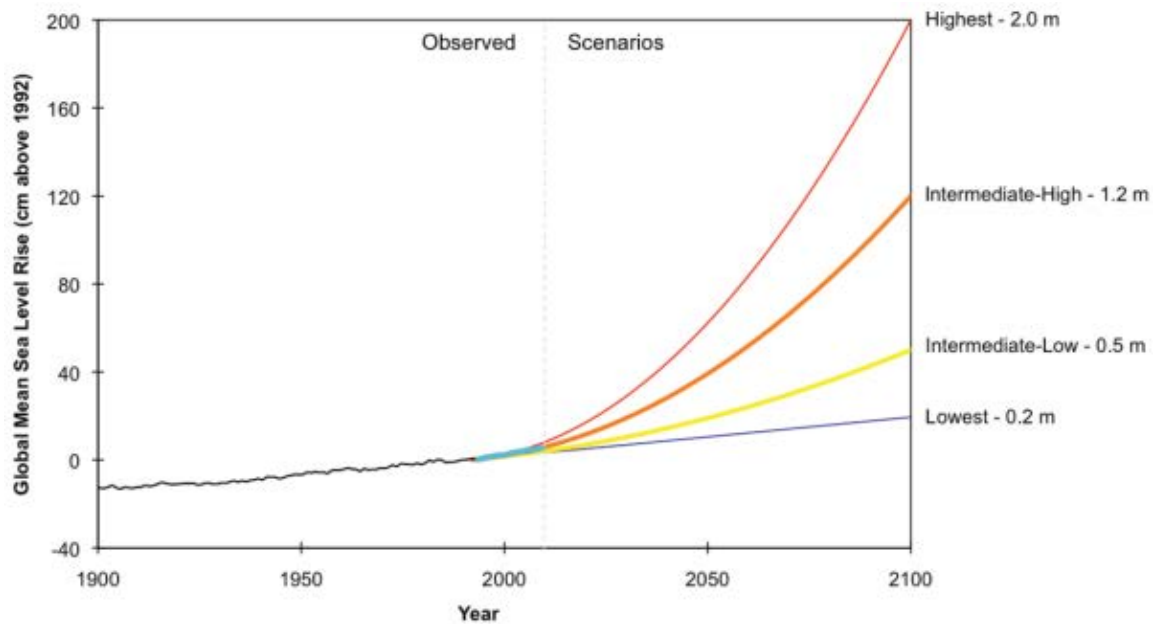


the 4<sup>th</sup> IPCC Report in 2007. While sea level rise is a major concern for all coastal communities, the secondary effects a much larger and broader scope of the population.



**Figure 29: Global Projections of Climate Change**

[Data and graphics by IPCC AR5, Working Group 1,  
[http://www.climatechange2013.org/images/figures/WGI\\_AR5\\_FigSPM-8.jpg](http://www.climatechange2013.org/images/figures/WGI_AR5_FigSPM-8.jpg)]



**Figure 30: Global Sea Level Rise Projection**

[Data and graphics by NOAA, <http://cpo.noaa.gov/Home/AllNews/TabId/315/ArtMid/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx>]

The Global Sea Level Rise Scenarios for the United States National Climate Assessment uses specific scenarios to determine projected sea level rise in relation to time. NOAA publications on sea level rise are based usually on actual sea level rise height independent of time. However, in this report, NOAA has provided a timeline.

#### Scenarios:

Lowest: based on historic rates of observed sea level change

Intermediate-low: based on projected ocean warming

Intermediate-high: based on projected ocean warming and recent ice sheet loss

Highest: based on ocean warming, maximum plausible contribution of ice sheet loss and glacial melting.

In relation to this project, time will not be used as a determinant factor. Design will be based and presented according to SLR only.

## Secondary Impacts of Sea Level Rise

Sea level rise is the major contributing factor of climate change that will be addressed in the research design project, and is therefore important to understand the secondary effects associated with sea level rise. The secondary effects of crucial concern to the project and as identified in The Pacific Islands Regional Climate Assessment (PIRCA) will be discussed in the following section.

According to the Pacific RISA website, *The Pacific Islands Regional Climate Assessment (PIRCA)* is, “A collaborative effort aimed at assessing climate change indicators, impacts, and adaptive capacity of the Hawaiian Archipelago and the US-Affiliated Pacific Islands (USAPI).” The topics included in the PIRCA are: climate variability, freshwater sustainability and drought, coastal inundation and sea level rise, and marine and terrestrial ecosystems. Selected secondary impacts of climate change and sea level rise directly from the PIRCA:<sup>87</sup>

- *Warmer and drier conditions mean that **freshwater supplies will decrease** on some Pacific Islands. Atolls and low-lying islands are especially vulnerable to freshwater shortages due to their small size and limited resources.*
- *Rising sea levels, exacerbated by storms, will **increase coastal flooding and erosion**, damaging coastal ecosystems and infrastructure and affecting agriculture, tourism, military bases, and other industries.*
- *Higher sea-surface temperatures will **increase coral bleaching**, leading to a change in coral species composition, coral disease, coral death, and habitat loss.*
- *Threats to the traditional lifestyles of indigenous communities may include destruction of coastal artifacts and structures, reduced availability of traditional food sources and subsistence fisheries, and the loss of the land base that supports Pacific Island cultures. These losses will **make it difficult for Pacific Island communities to sustain their connection with a defined place and their unique set of customs, beliefs, and languages.***

The PIRCA highlights the extensive effects of climate change and sea level rise. By identifying climate impacts, it is possible to better prepare adaptive solutions for cultural continuance through a physically changing environment.

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<sup>87</sup> Victoria W. Keener et al., *Climate Change and the Pacific Islands: Indicators and Impacts- Executive Summary of the 2012 Pacific Islands Regional Climate Assessment (PIRCA)* (Washington DC: Island Press, 2012), 4.



## Drivers of climate change

While climate change exists as a natural phenomenon, as discussed in the previous chapter, humans have caused a shift outside the natural variability of Earth. According to Steffen, Crutzen, and McNeil, in *The Anthropocene*, the onset of the Industrial Revolution in the early 1800's including water consumption and the depletion of natural resources marked the beginning of stage 1 of the anthropocene.<sup>88</sup> Stage 2 is further identified as the Great Acceleration beginning in 1945 or the end of World War II, and continuing to the present includes: the increase in greenhouse gasses, the continual depletion of the ozone layer, rising surface temperatures, and negative impacts to global biodiversity. Stage 3 of the anthropocene is recognition of human influence on the earth system.

## MITIGATION STRATEGIES AND INITIATIVES

The United Nations Framework Convention on Climate Change (UNFCCC) addresses mitigation initiatives as:<sup>89</sup>

*The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.*

Mitigation therefore becomes a vital long-term and future focused human intervention used to reduce the sources or enhance the sinks of greenhouse gases. As human action has altered and affected our current climate system, actions of today will be reflected in the future of tomorrow.

## COASTAL AND SMALL ISLAND COMMUNITIES

*Diverse indigenous peoples on islands live on the margins between sea and land and between survival and failure. Natural disasters they face include island subsidence, drought, loss of fresh water; rapid anthropogenic disasters include disease, invasion, and*

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<sup>88</sup> Will Steffen, Paul J. Crutzen, John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Forces of Nature," *Ambio: A Journal of the Human Environment* 36(8):614-621 (2007), accessed January 8, 2015, doi: [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[614:TAAHNO\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[614:TAAHNO]2.0.CO;2).

<sup>89</sup> M. Oppenheimer, and A. Peterson, *Article 2 of the UNFCCC: Historical Origins, Recent Interpretations* (Princeton University, 2004).

*nuclear testing; slow anthropogenic problems include deteriorating public health, social reorganization, economic globalization, and invasive species. Nonetheless, island peoples have extensive indigenous knowledge of environmental management that will be necessary for their survival in the face of climate change.*<sup>90</sup>

The geographic nature of coastal and small island communities results in higher vulnerability, exposure, and sensitivity to hazardous situations, extreme weather phenomenon, and long-term effects, caused by climate change. Sea-level rise, coastal erosion, cyclonic activity, storm surge, coastal inundation, ocean acidification will dramatically and negatively effect coastal ecology, food and water supplies, health, social stability, and economic stability. According to NOAA, more than 8 million people live in areas at risk of coastal flooding.<sup>91</sup> The Maldives and Kiribati are examples of countries currently facing sea level rise, re-establishing that climate change is a reality. Future projections illustrate Mokauea being eventually physically lost to sea level rise.

## **CONCLUSION**

While there exists extensive research and subsequent policy guidelines, issues of equity, justice, and fairness arise with respect to mitigation and adaptation strategies for indigenous peoples, and in this case, Native Hawaiians. As the climate system is dynamic and continuously evolving, we as humans, as part of that system, are inclined to also by part of this dynamic process, investigating all perspectives dealing with climate change. Climate data and projection charts tend to encompass a larger region, omitting crucial information from and for specific areas. Indigenous knowledge provides missing data vital in formation of appropriate solutions and actions.

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<sup>90</sup> Jan Salick and Anja Byg, "Indigenous Peoples and Climate Change," *Missouri Botanical Garden*, May 2007, accessed August 22, 2014, [http://www.ecdgroup.com/docs/lib\\_004630823.pdf](http://www.ecdgroup.com/docs/lib_004630823.pdf).

<sup>91</sup> "Global Sea Level Rise Scenarios for the United States National Climate Assessment," NOAA Climate Program Office, accessed January 12, 2015, <http://cpo.noaa.gov/Home/AllNews/TabId/315/ArtMID/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx>.



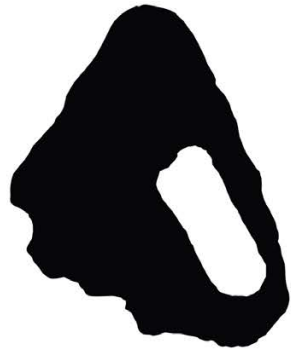
**Figure 31: Maldives Prone to Sea Level Rise**

[Image by National Geographic, <http://ocean.nationalgeographic.com/ocean/photos/sea-level-rise/>]

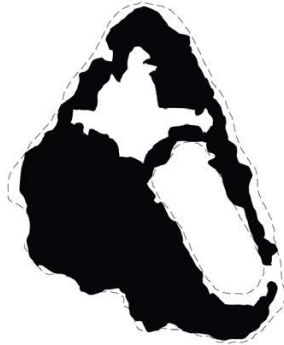


**Figure 32: Kiribati Will be gone in 60 years**

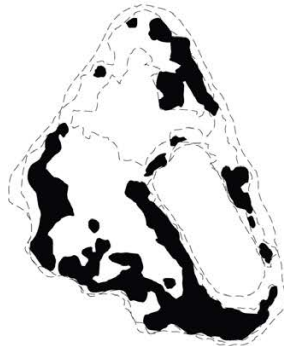
[Image by David Gray, courtesy of The Guardian, <http://www.theguardian.com/global-development-professionals-network/2014/oct/21/un-climate-debt-swap-is-fundamentally-unjust-say-development-agencies>]



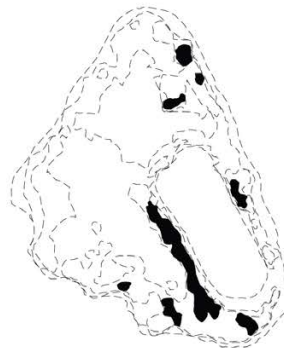
at Current MHHW



+ 1ft. SLR



+ 2ft. SLR



+ 3ft. SLR

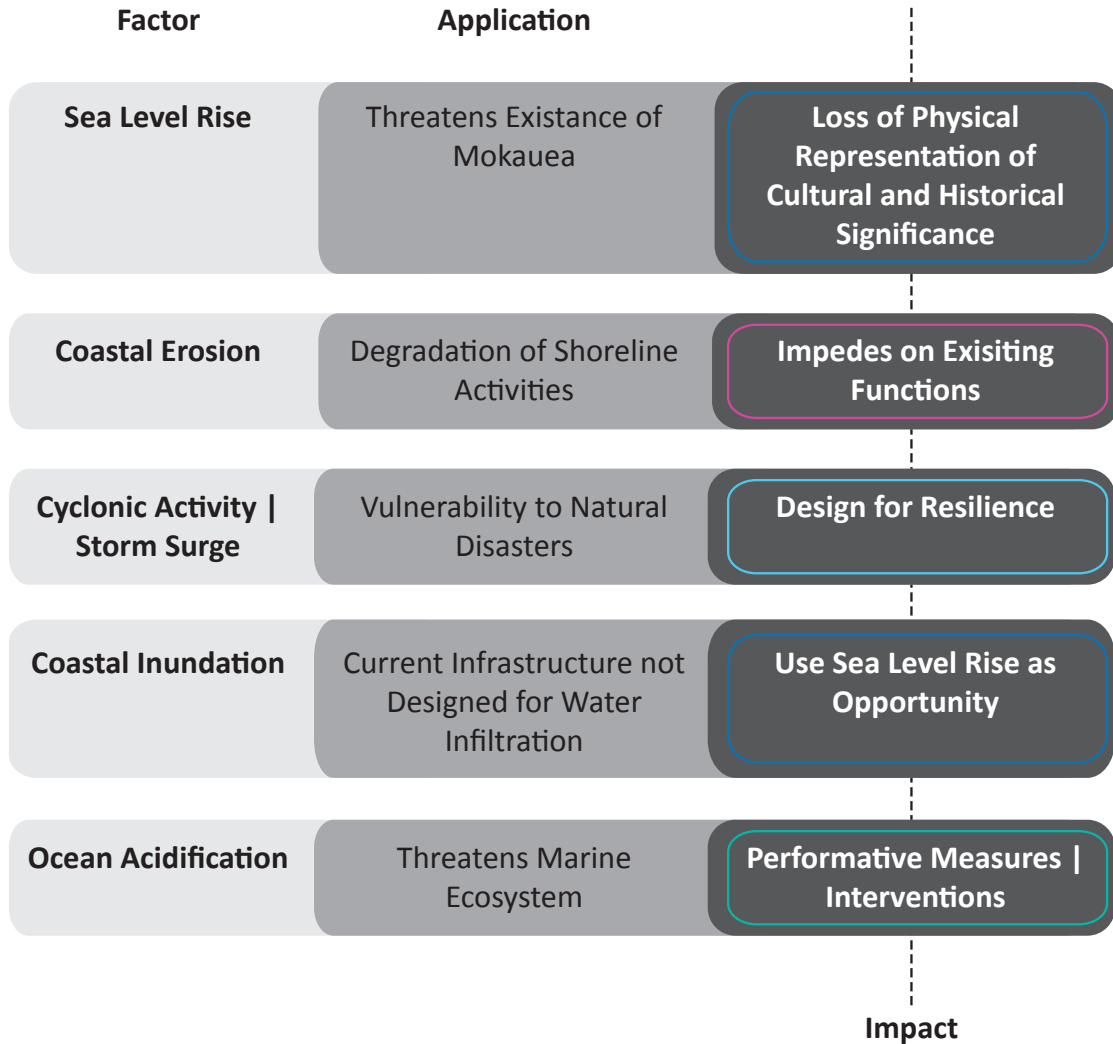
**Figure 33: Effects of Sea Level Rise on Mokauea**

[Data by DOT Rail Assessment, image by Bing Maps, graphic by author]



## ENVIRONMENT

[scientific climate change]



note: color-coding will be aid in organizational structure as illustrated in Chapter 6.

**Figure 34: Conclusion Diagram of Scientific Climate Change**  
[Graphic by author]

## CHAPTER 4. CLIMATE CHANGE [INDIGENOUS PERSPECTIVE]

*When these cultures are lost, their traditional ecological knowledge system is also lost taking with it the storehouse of long-term phenological data that we so desperately need.*<sup>92</sup>

Indigenous knowledge of climate change highlights the intimate connection with their environment based on observation and a cumulative historic knowledge base. Acclimation within modern societies, inhibit the process of the exchange of indigenous knowledge and ways of knowing, between generations, creating a disconnect with culture and a loss of identity. Indigenous knowledge on the effects on climate change parallels scientific methods, offering a different perspective of understanding and implementing adaptation strategies.

### INDIGENOUS PEOPLES

According to the *United Nations Permanent Forum on Indigenous Issues*, indigenous peoples are comprised of approximately 370 million people in 70 countries worldwide.<sup>93</sup> Due to diversity and uniqueness, the United Nations resists defining indigenous peoples, instead promoting and emphasizing the importance of the identification of indigenous peoples. The lack of a concrete, definitive, and universal definition of indigenous peoples prompts the collection of criteria in which indigenous peoples are to be identified and therefore acknowledged as such. Three widely accepted approaches will be presented to capture the essence of the definition or the meaning of indigenous peoples.

#### **ILO Convention no. 169**

*Because they are descendants of those who lived in the area before colonization; or because they have maintained their own social, economic, cultural and political institutions since colonization and the establishment of new states.*<sup>94</sup>

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<sup>92</sup> Bernard and Thuiller, "Introduction. Global change and biodiversity: future challenges," *Biology Letter* 4, 553-555.

<sup>93</sup> "Indigenous Peoples at the United Nations," United nations Forum on Indigenous Issues, accessed September 12, 2014, <http://undesadspd.org/indigenouspeoples.aspx>.

<sup>94</sup> "Convention No. 169," International Labour Organization, accessed September 22, 2014, <http://www.ilo.org/indigenous/Conventions/no169/lang--en/index.htm>.

### **Martinez Cobo's working definition**

*Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing in those territories, or parts of them. They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal systems.*<sup>95</sup>

### **United Nations**

1. *Self-identification as indigenous peoples at the individual level and accepted by the community as their member.*
2. *Historical continuity with pre-colonial and/or pre-settler societies*
3. *Strong link to territories and surrounding natural resources*
4. *Distinct social, economic or political systems*
5. *Distinct language, culture and beliefs*
6. *Form non-dominant groups of society*
7. *Resolve to maintain and reproduce their ancestral environments and systems as distinctive peoples and communities.*<sup>96</sup>

Indigenous people therefore are those who continually possess a distinctive characterization of cultural and social identity, existing prior to colonization. Often viewed as inferior to modernized or industrialized civilizations, indigenous and traditional peoples are rarely taken into consideration in academics, policymaking, and discourse on the impacts of climate change. Due to inhabitation of economically, politically, and environmentally marginal areas and fragile ecosystems, including tropical and temporal forest zones, low-lying coastlines, high mountainous area, flood plains and riverbanks, indigenous and traditional peoples will be severely and directly affected by climate change.<sup>97</sup> In most instances, livelihood is dependent on natural resources, as indigenous culture is dependent on ties to the land, and where economy, social organization, identity, cultural and spiritual values are linked to biodiversity. Survival and

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<sup>95</sup> "Definition of Indigenous Peoples," Netherlands Centre for Indigenous Peoples, accessed September 22, 2014, <http://indigenouspeoples.nl/indigenous-peoples/definition-indigenous>.

<sup>96</sup> "Who are Indigenous Peoples," United Nations Permanent Forum on Indigenous Issues, accessed September 22, 2014, [http://www.un.org/esa/socdev/unpfii/documents/5session\\_factsheet1.pdf](http://www.un.org/esa/socdev/unpfii/documents/5session_factsheet1.pdf).

<sup>97</sup> "Indigenous Peoples and Climate Change Adaptation in Asia," Asia Indigenous Peoples Pact, 2012, p9, accessed September 23, 2014, [http://www.iwgia.org/iwgia\\_files\\_publications\\_files/0656\\_IPs\\_and\\_Climate\\_Change\\_Adaptation\\_in\\_Asia.pdf](http://www.iwgia.org/iwgia_files_publications_files/0656_IPs_and_Climate_Change_Adaptation_in_Asia.pdf).

proliferation have been historically dependent on flexibility, resourcefulness, resilience, adaptability, and traditional knowledge.

## **TRADITIONAL ECOLOGICAL KNOWLEDGE [TEK]**

Traditional ecological knowledge or TEK, offers a fundamentally different worldview, allowing for the exploration of innovative strategies in response to climate change. TEK incorporates or more specifically is an intersection or overlap of spirituality, values, normative rules, cultural practices, along with ecological, environmental, and biodiversity knowledge.<sup>98</sup>

TEK or traditional ecological knowledge was rediscovered in the 1980's through anthropological research of indigenous and traditional peoples. TEK is the acquired knowledge that is handed down through generations, through observation, and experience of the natural environment around them as a result of sustained contact with the land. Furthermore, as explained by Fikret Berkes in *Traditional Ecological Knowledge in Perspective*, "TEK is a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment."<sup>99</sup> TEK therefore is not quantifiable data, but a knowledge of procedural ecology built by generations of intimate personal experience.

As witnessed through recent news and journal articles, as well as the IPCC report summaries, publications are now acknowledging the importance of indigenous knowledge. While the value of traditional ecological knowledge is recognized and continually grows in importance, there is still a distinctive disconnect between scientific knowledge and indigenous knowledge.

TEK is an ephemeral knowledge base held in thoughts, chants, songs, and stories, which differs from the databases and books of the western worldview. Validity of TEK is often questioned and only deemed relevant when validated by Western Science, and in many instances used to solely validate earlier scientific studies.

The validity of TEK is proven through continued existence and known expertise in agroforestry, traditional medicine, biodiversity, conservation, resource management, applied anthropology, impact assessment, and natural disaster preparedness.

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<sup>98</sup> Jules Pretty et al., *How do Biodiversity and Culture Intersect*, Sustaining Cultural and Biological Diversity In a Rapidly Changing World: Lessons for Global Policy Conference, organized by American Museum of Natural History's Center for Biodiversity, 2008, accessed September 24, 2014, <http://www.greenexercise.org/pdf/How%20do%20biodiversity%20and%20culture%20intersect.pdf>.

<sup>99</sup> Fikret Berkes and Julian T. Inglis (ed), *Traditional Ecological Knowledge: Concepts and Cases* (=Canda: International Program on Traditional Ecological Knowledge, 1993).



## EXAMPLES OF INDIGENOUS KNOWLEDGE

Within the IWGA report on Indigenous Peoples and Climate Change Adaptation in Asia, a brief selection of changes observed by a community in their environment include:<sup>100</sup>

- *Frost that use to be there in the month of October has disappeared*
- *Disappearance of some species of bird and appearance of new species of bird*
- *Crops that used to grow well in their villages are no longer good and crops that did not grow before are growing well now (shifting to higher altitude)*
- *Appearance of more pest and new weeds*
- *Two types of rain patterns that they used to received in the month of October has not been seen in these last few years*
- *Springs and water holes are drying up*
- *Only few hillock gibbons found in their forest now*
- *Particular type of mushroom which use to be there in their forest is not seen any more*

Indigenous peoples possess a unique sensitivity to the environment, and as such, TEK is based on the balance between man and the environment.



### The Inuit

The Inuit are native to Arctic regions of Alaska, Canada, Greenland, and Russia, with a combined population of 160,000.<sup>101</sup> The Inuit are one of the most documented indigenous peoples (in relation to TEK), and is selected to illustrate the importance of TEK in relation to climate change as described in the Advanced Guard Compendium report.<sup>102</sup>



**Figure 35: Inuit Examples of Intimate Knowledge of Seasonal and Animal Migration**

[Top to bottom: Peary Caribou, Beaufort Sea Bowhead Whale, Musk-Oxen]

<sup>100</sup> "Indigenous Peoples and Climate Change Adaptation in Asia."

<sup>101</sup> "Welcome," Inuit Circumpolar Council-Greenland, accessed February 17, 2013, <http://inuit.org/dk.html>.

<sup>102</sup> Kristy Galloway McLean, *Advance Guard: Climate Change Impacts, Adaptation, Mitigation and Indigenous Peoples- A compendium of Case Studies* (Australia: United Nations University, 2010).

- *This relates to Inuit knowledge that survival of Peary caribou in the High Arctic depends upon the social structure of the small herds in winter. Therefore, the management of these caribou for sustained harvesting requires, in addition to an overall quota system, the nonselective hunting of all animals encountered opportunistically rather than through the management system instituted by scientists where selective hunting of large males is advocated with a prohibition on hunting females and immature animals. The TEK view holds that only hunting large males will quickly result in the accelerated death of the remaining population, a view that has been born out by subsequent monitoring of the south Ellesmere Island regional population.*
- *Inuit TEK of the social structure and behaviour of musk-oxen (an animal not at the time hunted due to a 50-year-old management restriction) argued that scientists' ideas of "solitary and surplus" males were incorrect, and that such animals play an important role in enhancing musk-oxen population survival. Therefore, instituting a program to harvest such "surplus" animals would prove unwise. Such views, contradicting scientists' conventional wisdom, were nevertheless independently corroborated.*
- *Scientific surveys indicated the Beaufort Sea bowhead whale population was very depleted, with only about 800 whales surviving in 1977. Local hunters stated the whale population was about 7000. They also took issue with assumptions underlying scientists' population estimates (e.g., that whales only migrated in open water leads, and were incapable of swimming under the ice offshore and did not feed during migration). On the other hand, Inuit hunters believe whales migrate hundreds of miles offshore under the ice and therefore cannot be censused by visual means alone. On the basis of these methodological criticisms, a sophisticated survey technique was developed, incorporating Inuit assumptions (later verified). Using the new census methods the 1991 bowhead population was conservatively estimated to be in excess of 8000 whales, despite an annual harvest of between 20 and 40 whales over the past decade. The findings tended to confirm the Inuit 1977 population assessment of about 7000 animals.*
- *In 1979 biologists warned, from the results of aerial censuses, that the barren-ground caribou west of Hudson Bay were seriously depleted and overhunted. The Inuit hunters disputed these findings and the prognosis that the herds were about to become extinct. Scientists claimed a decrease of approximately 100 000 animals had occurred in just a few years. Inuit countered that the census techniques were deficient and that recent changes in seasonal caribou distribution also contributed to the low census figures. To resolve the conflict, surveys were carried out by census techniques suggested by Inuit hunters. The result was that population estimates increased by approximately 100 000*

*caribou, thus confirming that the herds were not threatened by "overhunting" and extinction.*<sup>103</sup>

Due to extreme weather conditions, the Arctic is one of the first regions to experience the effects of climate change. A strong and intimate connection and relationship with the living environment allows for the observation and identification of changes in weather patterns and animal behavioral patterns.



### **Hawaii**

Within the United States, there are three recognized indigenous groups: Indian tribes, Alaska Native peoples, and Native Hawaiians. While native Hawaiians are classified as indigenous peoples, they are not federally recognized, and therefore lack the freedom to regulate their own lands and resources as a form of self-governance.<sup>104</sup> Although an integrated indigenous community, the Native Hawaiian culture remains deeply rooted within the environment, and are experiencing climate change impacts.



**Figure 36: Native Hawaiian Examples of Intimate Knowledge**  
[Top to bottom: Dryland Taro, Hawaiian Salt, drying of water resources]

The Native Hawaiian Symposium on Climate Change in 2012, led by the Center for Island Climate Adaptation and Policy, facilitates sustainable and climate-conscious future for Hawaii, the broader Pacific region, and global island communities. Using an interdisciplinary approach, the goal of the symposium is to educate, create an action plan, and promote awareness of climate change. Some observations discussed at the 2012 symposium included: the pushing back of seasons, longer summers, less rainfall, drying of water resources, and abrupt and shifted transition of seasons.<sup>105</sup>

<sup>103</sup> Milton M. R. Freeman, "The Nature and Utility of Traditional Ecological Knowledge," *Canadian Arctic Resources Committee*, accessed January 12, 2015, <http://www.carc.org/pubs/v20no1/utility.htm>.

<sup>104</sup> "Hawaiians Seek Same Rights as Americans Indians," National Public Radio, accessed January 2, 2015, <http://www.npr.org/templates/story/story.php?storyId=4762516>.

<sup>105</sup> Duit et al., "Governance, Complexity, and Resilience," *Global Environmental Change* Volume 20, 2010, 363-368, accessed November 12, 2014, <http://www.sciencedirect.com/science/article/pii/S095937801000035X>.

## SCIENTIFIC AND INDIGENOUS INTEGRATION

Historically, and mistakenly, the scientific community perceived the social sciences, and in particular, TEK, to be of limited usefulness or inferior heretics. According to Duit et al., in *Global Environmental Change*, “As among others Hall (2003) and Pierson (2004) have convincingly shown, research methods in social science, almost regardless of underlying epistemologies, have to a large extent been based on a linear and static ontology. By and large, there has been a strong tendency within mainstream social science to view the world as governed by linear and probabilistic relationships that are, in principle, knowable through analytical techniques based on the principles of methodological individualism and aiming at reducing variation in empirical data to uncover regularities and correlational patterns (cf. King et al., 1994)” and, “As a consequence, processes and events that are not linear, sufficiently short-term, or possible to reduce to the actions of individual actors will tend to be overlooked or misinterpreted by traditional social science analyses. Most contemporary theoretical models and analytical techniques in the social sciences are therefore insufficient for adequately capturing processes of complex change in natural as well as social systems.”<sup>106</sup>

As stated earlier, science includes factual data requiring supporting evidence, and in terms of climate change modeling, tends to focus on the larger global picture. Indigenous and traditional knowledge provides information on local climate changes. While science, tends to be proprietary, TEK acts as an open source of information. Unfortunately, while both perspectives retain a distinctive area of origin, expertise and guiding principles, it is these same differences that cause a dichotomy.

Anthropologist Claude Levi-Strauss argues that scientific knowledge and traditional ecological knowledge are parallel modes of acquiring knowledge about the universe in which “the physical world is approached from opposite end in the two cases: one is supremely concrete, the other supremely abstract.”<sup>107</sup> An interview with Michael Butchins on NatGeo, reinforces this phenomenon, suggesting that scientific and traditional knowledge work complementary, blurring the dichotomy and creating the merit of coexistence.<sup>108</sup>

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<sup>106</sup> Duit et al., “Governance, Complexity, and Resilience,” *Global Environmental Change* Volume 20, 2010, 363-368, accessed November 12, 2014, <http://www.sciencedirect.com/science/article/pii/S095937801000035X>.

<sup>107</sup> Claude Levi. Strauss, *The Savage Mind* (Great Britain: The Garden City Press Limited, 1962), 269.

<sup>108</sup> “Traditional Ecological Knowledge (TEK): An Interview With Dr. Michael Hutchins,” National Geographic, accessed November 21, 2014, <http://newswatch.nationalgeographic.com/2014/01/11/indigenous-people-their-interface-with-wildlife-an-interview-with-dr-michael-hutchins/>.

Traditional ecological knowledge and its application can be used to enlighten or enhance environmental assessment, and offers a different perspective or worldview. The bridge of scientific and traditional knowledge creates a foundation for discussion and appropriate plans of action.

## **INDIGENOUS ADAPTATION**

As reported by the IWGA in Indigenous Peoples and Climate Change Adaptation in Asia, indigenous communities have already developed specific coping strategies, such as:<sup>109</sup>

- *Crop diversification to minimize risk of harvest failures—varieties of crops with different susceptibility to droughts, floods, pest etc. or varieties adapted to different locations such as river banks, high mountains, and close to primary forest etc.*
- *Change of hunting and gathering periods to adapt to changing animal migration and fruiting periods.*
- *Increasing food preservation and improving preservation methods and techniques.*
- *Introduction of food banking and seed banking along with creation of exchange networks among the communities.*
- *Changes in food habits—improving forest conservation and reverting to gathering food in the forests during bad harvest.*
- *Introduction of multi-cropping, double cropping and relay cropping systems as appropriate by many communities.*
- *Altering land use and settlement patterns.*
- *Other measures such as conservation of forests and watershed, including restoration of ecosystems.*
- *Awareness raising and solidarity actions to ensure or to address the concerns of indigenous peoples.*

The Indigenous and Traditional Peoples and Climate Change Issues paper also provides examples of traditional and innovative adaptation practices that include:<sup>110</sup>

- *Shoreline reinforcements*
- *Improved building technologies*
- *Rainwater harvesting*
- *Supplementary irrigation*
- *Traditional farming techniques to protect watersheds*

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<sup>109</sup> "Indigenous Peoples and Climate Change Adaptation in Asia."

<sup>110</sup> Mirjam Macchi et al., *Indigenous and Traditional Peoples and Climate Change-Issues Paper* (IUCN, 2008).

- *Changing hunting and gathering periods and habits*
- *Crop and livelihood diversification*
- *Use of new materials*
- *Community based disaster risk education*

Hawaii will host the next IUCN World Conservation Congress in 2016, the world's largest conservation event. The goal of the IUCN report on Indigenous People and Climate Change are: to improve understanding of the potential impacts of climate change of vulnerable communities and cultures and their associated ecosystems, to identify further research required to reduce the risks of climate change, and to develop appropriate adaptation and mitigation measures, particularly in areas with high risk of socio-cultural impacts.<sup>111</sup>

Many of indigenous communities have preserved traditional knowledge about agriculture, hunting, fishing, foraging and the use of medicinal plants. In the past, many of these communities have been exposed to different kinds of environmental changes and have developed coping strategies to face these phenomena.

## **CONCLUSION**

The effect or inevitability of sea level rise has not caused major concern in most coastal urban areas. Many countries such as Tuvalu in the Pacific, the Maldives, and the state of Hawaii are increasingly aware of sea level rise, but have yet to implement adaptation or resiliency strategies.

The entire human race is experiencing the effects of climate change. While providing a disproportionate impact to the environment, indigenous communities are the most exposed to the negative impacts of climate change. Natural resilience and adaptability of indigenous peoples stems from keen observation, intimacy with their environment, and the accumulation of traditional ecological knowledge. Indigenous adaptation strategies provide insight into resilience towards climate change, providing inspiration to the rest of the world.

*New ideas and techniques may be incorporated into a given tradition, but only if they fit into the complex fabric of existing traditional practices and understandings. Thus traditions are enduring adaptations to specific places.... Traditions are the products of*

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<sup>111</sup> Mirjam Macchi et al., *Indigenous and Traditional Peoples and Climate Change*.

*generations of intelligent reflection tested in the rigorous laboratory of survival. That they have endured is proof to their power.*<sup>112</sup>

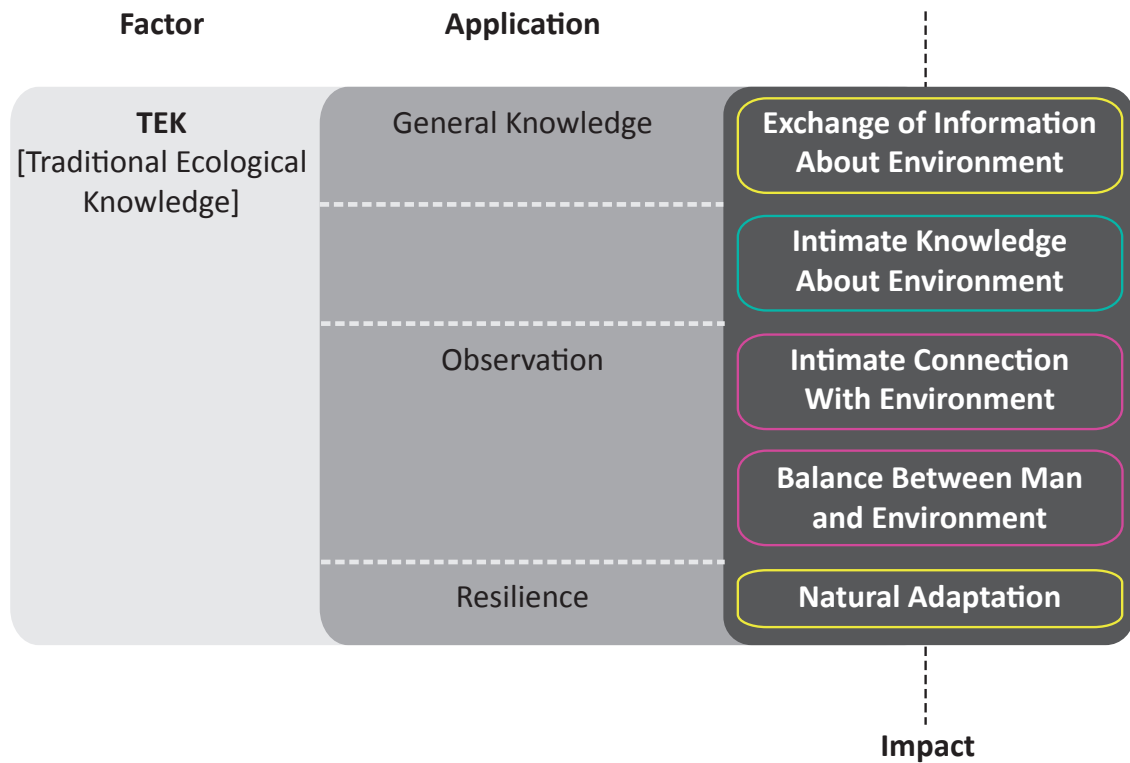
Climate change and the natural environment is the final component of the embodiment of sense of place. The relationship of the environment and future projections with an existing community infused with Native Hawaiian culture, constructs an understanding of an acute specific sense of place for the entire Ke'ehi Lagoon area, including Mokauea Island. The development of perspective leads towards a design intervention that incorporates sensitive design and appropriate decision-making.

The next chapter will present worldwide adaptation strategies, witnessed throughout time, that address water infiltration and sea-level rise.

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<sup>112</sup> Eugene Hunn, N. Williams and G. Baines (eds.), *What is traditional ecological knowledge? In Traditional ecological knowledge: wisdom for sustainable development* (Canberra: Centre for Resource and Environmental Studies, 1993), 13-15.

**ENVIRONMENT**  
[indigenous climate change]



note: color-coding will be aid in organizational structure as illustrated in Chapter 6.

**Figure 37: Conclusion Diagram for Indigenous Perspective of Climate Change**  
[Graphic by author]



## CHAPTER 5. ADAPTATION STRATEGIES

Adaptation differs from an adaptation strategy.

According to Pulitzer Prize recipient for National Reporting, Inside Climate News published an article that, “The world could end up spending between \$49 billion and \$171 billion a year through 2030 on adaptation, according to UN figures. Some scientists put the figure at up to three times that amount. When published in June of 2013, an estimated 20% of cities around the world had developed adaptation strategies in response to climate change. UN-financing initiative spurred \$11 billion towards developing countries and adaptation strategies. In contrast, New York City alone initiated a \$19.5 billion adaptation plan.”<sup>113</sup>

The lifestyle of indigenous peoples offer the least contribution to climate change, while being the most affected. Lands that have been inhabited for generations and thousands of years will be obsolete or inhabitable or unable to sustain a traditional way of living. As Indigenous peoples will be the first to feel the impact of climate change, emphasis must be placed on mitigation, resilience, and adaptation strategies.

Indigenous peoples are keen and active observers of climate changes who are readily adapted to face changing climate conditions. Many indigenous societies have preserved traditional knowledge about agriculture, hunting, fishing, foraging and the use of medicinal plants. In the past many of these communities have been exposed to different kinds of environmental changes and have developed coping strategies to face these phenomena.

As defined by the UNFCCC, adaptation is about finding and implementing ways of adjusting to climate change and responding to climate change risks and vulnerabilities. Adaptation in relation to climate change is dynamic and can be categorized into autonomous or planned and short, medium and long term. Climate change adaptation is any adjustment or action undertaken that either moderates or reduces the adverse consequences of climate change or exploits beneficial opportunities in response to actual or expected climate-related changes in natural ecosystems and human systems.<sup>114</sup>

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<sup>113</sup> "6 of the World's Most Extensive Climate Adaptation Plans," Inside Climate News, accessed December 13, 2014, <http://insideclimatenews.org/news/20130620/6-worlds-most-extensive-climate-adaptation-plans>.

<sup>114</sup> "UN Climate Change Newsroom," UNFCCC, accessed September 9, 2014, <http://newsroom.unfccc.int>.

The examination and use of case studies as a research methodology, reveals the intent, decision-making process, related contextual conditions, and final implementation of an architectural design. Working as an investigation within real-life context, examination and analysis leads to an evaluation of the integrity of the design. Case studies increase the available body of knowledge and promote a greater perspective, by learning from others. The selected case studies were chosen for analysis based on this question: How are others dealing with climate change, and in particular, sea level rise?

The indication of sea-level rise as a direct result of anthropogenic climate change has propelled a push for an adaptation strategy. The following case studies will be presented in an order that represents adaptation strategies increasing in sensitivity and integration of design interventions. Some case study selections are in theoretical or conceptual form but are used to highlight the differentiation in suggestive solutions.

#### **HOWARD HUGHES CORPORATION**



**Figure 38: Ward Village Model by Howard Hughes Corp., Ward Village Gallery**

[Image by Honolulu Magazine, courtesy of HCDA, edited by author <http://www.honolulumagazine.com/Honolulu-Magazine/April-2014/Hawaii-Construction-Boom-New-Developments-Coming-to-Honolulu-North-Shore-Central-West-and-Windward-Oahu/>]

Development along coastal areas, have failed to address climate change and sea level rise. Developers are only interested in the short term, as sea-level rise will most likely not dramatically affect Hawaii for another 50 years or so. However, eventually, there will be a need for the built environment to work with sea-level rise and water inundation.

According to their website, the Howard Hughes Corporation, “owns, manages and develops commercial, residential and mixed-use real estate throughout the country.” and “is comprised of master planned communities, operating properties, strategic developments and other unique assets spanning 16 states from New York to Hawaii.”<sup>115</sup> In Hawaii, Howard Hughes Corp. holds a large stake hold of the Ward | Kaka‘ako area, and has a master plan incorporating 22 high-rise buildings and over 9 million sq. feet of development. Howard Hughes is also deemed a trendsetter, holding a LEED Neighborhood Design Platinum by the U.S. Green building Council for their Ward Village project. Designs are incorporating larger setbacks than regulated, are concerned about creating a mixed-use neighborhood, and include cultural associations within their architectural designs.<sup>116</sup> While designers are taking inspiration from the ocean, using cues from historic fishing, relating to existing geological relationships, and incorporating Hawaiian folklore, there is little in the response to climate change and sea level rise.

Waiea is the most celebrated high-rise out of the Howard Hughes Ward collection, located on the makai side of the existing Ward Theaters. Waiea’s Canadian-based architect James K.M. Cheng admits that, “We’re aware of the possibility of sea-level rise, that in 50 years it could be higher than today.”<sup>117</sup> However, the only response to sea level rise is to place essential equipment in the building placed above grade, and use the concrete walls on the makai or ocean side of the building to protect from possible storm surges. These projects are an unfortunate prime example of the lack of response to climate change and sea-level rise, and ignoring the premise of the responsibility of the architect.

## **THE NETHERLANDS**

The Netherlands is home to the largest and oldest form of land reclamation beginning over 2000 years ago. The Netherlands boasts a quarter of their total land area as artificial or reclaimed land. Originally a coastal area ravaged by rising sea levels and tidal action, flood control measures started off as nothing more than refuge mounds.<sup>118</sup> These refuge mounds known locally as *terpen*, were slowly connected to create a rudimentary flood control system. At the same time, agriculture land was in high demand. This was easily obtained by outfitting

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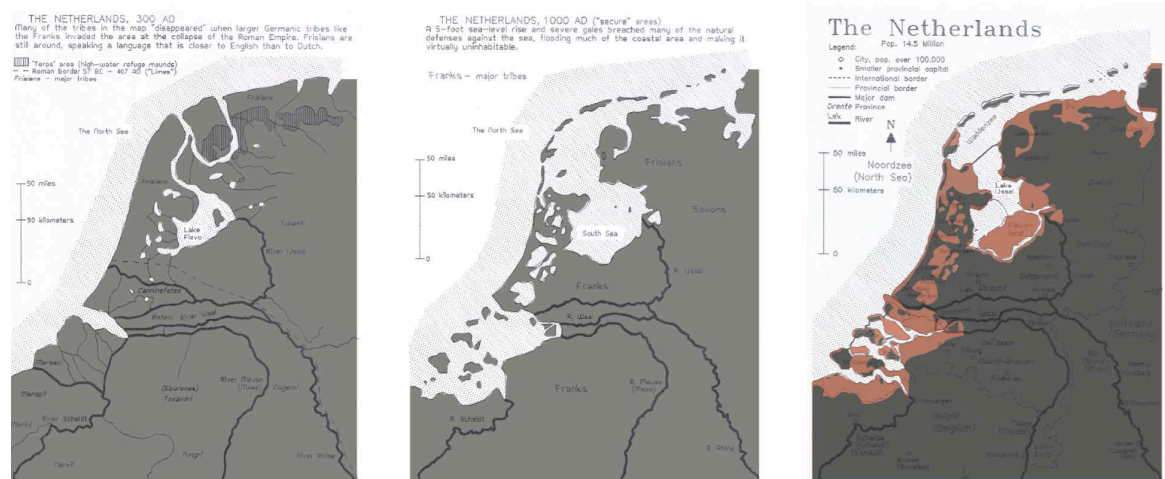
<sup>115</sup> “Home Page,” The Howard Hughes Corporation, accessed February 14, 2015, <http://www.howardhughes.com/index.php>.

<sup>116</sup> “High-rises Design Inspired BY the Ocean,” Hawaii Business, accessed July 12, 2014, <http://www.hawaiibusiness.com/high-rises-design-inspired-by-the-ocean/>.

<sup>117</sup> *Ibid.*

<sup>118</sup> Land Reclamation Rotterdam," NASA, Accessed March 12, 2013, <http://earthobservatory.nasa.gov/IOTD/view.php?id=47122>.

drainage canals into existing peat swamps. Although many hectares of usable agricultural land was formed, the drawback was land subsidence or the sinking of land due to soil shrinkage, consolidation, and oxidization.<sup>119</sup>



**Figure 39: Land Reclamation in the Netherlands**

[Data and image by Heard Dutch Here, <http://www.hearddutchhere.net/NL1650.html>, graphic by author]

This situation called for a more active form of flood control and prompted the introduction of dikes. Throughout the next centuries until the present time, the Netherlands have developed a solid system of dikes, dams and levees to prevent water infiltration and an increase of arable land. The greatest technological achievement was the Afsluitdijk dam which turned the Zuiderzee into the IJsselmeer lake. This formed a protected water system in which 4 artificial sections of land could be developed.<sup>120</sup> The physical composition of the Netherlands today is very different than the original. Technological inventions allowed for such transformations as in the Netherlands.

The use of high engineering puts the system at risk. Levees, dams and dikes fail, and when they do, they fail in a big way. This solution, while working for centuries, aims at keeping water out versus working with the water towards an integrated solution.

<sup>119</sup> "Subsidence due to peat decomposition in the Netherlands," Fringe, accessed May 2, 2013, [http://earth.esa.int/fringe07/participants/559/pres\\_559\\_carocuena.pdf](http://earth.esa.int/fringe07/participants/559/pres_559_carocuena.pdf).

<sup>120</sup> Subsidence due to peat decomposition in the Netherlands," Fringe, accessed May 2, 2013, [http://earth.esa.int/fringe07/participants/559/pres\\_559\\_carocuena.pdf](http://earth.esa.int/fringe07/participants/559/pres_559_carocuena.pdf).

## WATERSTUDIO



**Figure 40: Floating Private Residence in Amsterdam by WaterStudio, 2008**

[Image by Waterstudio, <http://www.waterstudio.nl/projects/48>]



**Figure 41: The Sea Tree, Non-Human Contact Structure, Wildlife Habitat, Urban Areas**

[Image by Waterstudio, <http://www.waterstudio.nl/projects/79>]

Koen Olthius is from the Netherlands, a country that has a long-term relationship with water spanning over centuries. Koen and WaterStudio believe that the Netherlands should think about working with the water instead of against it. Up to this point in time, the Netherlands' strategy has been a defensive tactic. But as early preliminary research has shown, "The prognoses is that by 2050 approximately 70% of the world's population will live in urbanized areas. Given the fact that about 90% of the world's largest cities are situated on the waterfront, we have arrived to a situation where we are forced to rethink the way we live with water in the built environment."<sup>121</sup> The migration towards urbanized cities which are predominantly located along coastal areas coupled with the climate change, presents a problem that needs to formulate a solution now.

In response to the situation, Koen explains that cities need to be more flexible and should change with the demand of the people. Koen states that , "Architecture is static in a dynamic world."<sup>122</sup> Within a society, needs and demands change over time and therefore present dynamic characteristics Architecture should be able to respond or support these dynamic conditions. Koen ultimately agrees that at the moment, the biggest problems are that cities are full and that there is a need to find space, and that we need to start thinking about climate change and the response. He believes that people need to start building for change. Building on water in areas that afford it could be the answer.

His studio has completed several projects within the past few years that have directly addressed these concerns. Many are small-scale residential projects. However, there are plans for larger-scale projects in the Maldives, the United Arab Emirates, and of course in the Netherlands.<sup>123</sup> Instead of relying on the dam and dike system to afford areas to develop, he is promoting the idea of water-based architecture that is able to respond to differential water levels due to climate change. His projects have helped once again to transform the Netherlands, and future developments around the world.

While Koen has been at the forefront of floating design, the designs do not take full advantage of ecological attribution or contributions. The most influential portion of his work is the ability to inspire. They have successfully completed projects and brought to life a new perspective that the ocean is not something to be feared, but to be appreciated and used.

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<sup>121</sup> "Vision," WaterStudio, accessed February 8, 2013, <http://www.waterstudio.nl/vision>.

<sup>122</sup> "Float! Flexible Land on Aquatic Territory," UP Experience via WaterStudio, accessed February 8, 2015, <http://www.waterstudio.nl/vision>.

<sup>123</sup> "Vision."



## LILY PAD



**Figure 42: Floating Ecopolis, aka the Lilypad, Self-Sustaining Retreat Design**

[Image by Vincent Callebaut Architectures, [http://vincent.callebaut.org/planche-lilypad\\_pl31.html](http://vincent.callebaut.org/planche-lilypad_pl31.html)]



**Figure 43: Floating Ecopolis Underwater View**

[Image by Vincent Callebaut Architectures, <http://vincent.callebaut.org/page1-img-lilypad.html>]

The Lilypad is a conceptual design imagined by Belgian architect, Vincent Callebaut. The design is a reflective forward-thinking response to human displacement due to rising ocean levels. According to his website, [vincent.callebaut.org](http://vincent.callebaut.org), the concept for the overall form of the floating city uses bio-mimicry as inspiration and is modeled after the Amazonia Victoria Regia lily pad which is an aquatic plant.<sup>124</sup>

Callebaut takes his information from the GEIC or Intergovernmental Panel on Climate Change who predicts that the sea levels will rise by 60-90cm during the current century. They also state that if the sea water level were to raise 1 meter, the result would be a total of 50 million people affected. The second meter rise would cause massive deterioration of arable coastal land. New York, Bombay, Calcutta, Hô Chi Minh City, Shanghai, Miami, Lagos, Abidjan, Djakarta, Alexandria and not less than 250 million of climatic refugees and 9% of the GDP will be threatened if we do not build protections related to such a threat.<sup>125</sup>

Callebaut's conceptual design is essentially an auto-sufficient amphibious city. He believes that this solution is not meant to be a temporary solution, but one that is long lasting and has the potential to redefine the definition and visual identity of cities.

Technically, it also satisfies the four challenges laid down by the OECD or Organization for Economic Co-operation and Development of climate, diversity, water, and health. The Lilypad integrates sustainable energy solutions of solar thermal, solar photovoltaic, wind, hydraulic, tidal, osmotic, phytopurification, and biomass.<sup>126</sup>

One problem with conceptual design is the tendency to be overly poetic or graphic with the overall form and presentation. After all, because it is a conceptual design, it is necessary to gain an audience to sell your product. However, the shape literally mimics a lily pad. Is this good design for stability or usability? In his description of the project, the lily pad is used primarily as a conceptual formal idea of inspiration. It does not specifically state how the form reacts to water conditions and climate changes. The inability to inform the public on usage and function, keep this project in the realm of conceptual. For instance, from the rendered images, it looks as if 80% of the structure is above ground, and is truly floating on the water.

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<sup>124</sup> "Lilypad, A Floating Ecopolis For Climate Refugees," Vincent Callebaut Architectures, accessed March 20, 2012, <http://vincent.callebaut.org/page1-img-lilypad.html>.

<sup>125</sup> *Ibid.*

<sup>126</sup> *Ibid.*



What it offers is inspiration. Already, JDS Architects have created a smaller scale spin-off of the lily pad entitled the Mermaid building.<sup>127</sup> Just as aesthetically pleasing as the Lily pad, they used curvilinear forms to enhance the building. But is this just for show? is the shape really determined by the most efficient or comprehensive understanding of a floating structure?

The use of floating architecture offers an alternative to land-based development, providing a solution lending to a retreat plan. However, designs that are not land based tend to be void of sense of place, cultural infusion, and disregards or ignores the problems of land based climate change and sea level rise. Although promoted as self-sustaining, the LilyPad is heavily dependent and reliant on available technology and materials.

### **CHINA WETLAND PARKS**

China is riddled with population growth and urban development. Wetland park design incorporates human interaction and involvement without intrusion to site and performative aspects. Both projects are designed by Chinese design group Turenscape, founded by Dr. Kongjian Yu, operating as an integrated team that provides holistic design services in the fields of architecture, landscape architecture, urban planning and design, and environmental design.

#### **Tanghe River Park**



**Figure 44: Tanghe River Park, aka Red Ribbon Park, by Turenscape**

[Image by American Society of Landscape Architects, <http://www.asla.org/sustainablelandscapes/redribbon.html>]

In Qinhuangdao, Hubei, China, architect group Turenscape has developed a form of human occupation within a previously uninhabitable natural site. Qinhuangdao park is located

<sup>127</sup> "Mermaid Inspired Building," JDS Architects, accessed February 12, 2013, <http://inhabitat.com/mermaid-inspired-aquatic-building-by-jds-architects/>.

on the Tanghe River and was faced with concrete embankment water channel development. The proposed solution is a red ribbon of walkways integrating lighting, seating, environmental interpretation, and orientation.<sup>128</sup>

The existing site covered with native vegetation and acting as habitat for assorted species became a garbage dump due to its uninhabited location in close proximity to an urban community. Urban sprawl prompted a venue for recreation including fishing, swimming, and jogging.<sup>129</sup>

The red ribbon of benches provides a platform for recreational and environmental education uses, while preserving the natural habitats. The Red Ribbon Park offers a minimalist design solution that finds a balance between human intervention and natural environments.

### **Qunli Stormwater Wetland Park**



**Figure 45: Qunli Stormwater Park by Turenscape**

[Image by ArchDaily, [http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/52799d8de8e44e8654000098\\_qunli-stormwater-wetland-park-turenscape\\_qunli08-jpg/](http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/52799d8de8e44e8654000098_qunli-stormwater-wetland-park-turenscape_qunli08-jpg/)]

Another project by Turenscape, Qunli Stormwater Park uses the same guiding principles in the design solution. Located in Harbin, China, Qunli natural urban wetland constitutes a large

<sup>128</sup> "Red Ribbon Park/Turenscape," ArchDaily, accessed February 14, 2015, <http://www.archdaily.com/445661/red-ribbon-park-turenscape/>.

<sup>129</sup> "Welcome to Turenscape," Turenscape, accessed February 14, 2015, <http://www.turenscape.com/english/projects/project.php?id=336>.

city block near the outer fringe of an urbanized city. Surrounded by dense development, the protected regional wetland faced a reduction in water sources and would eventually become dry and obsolete. The goals of the project were to rescue the wetland while maintaining multiple ecosystem services for the new urban community.<sup>130</sup>

A system of ponds and mounds were developed around the site to allow the collection, filtration, and storage of urban storm water before infiltrating into the wetland to ensure the productiveness and performative aspects of the wetland. Recreational and aesthetic experiences for the city were created by using layers of human intervention and interaction. Ground level walkways allow close contact with nature, and an elevated skywalk allows for a canopy experience while allowing continued use during flooding.<sup>131</sup>

This design solution as compared to the Red Ribbon Park has a more engineered design and built structures, but still allows for the performance of the park as a natural wetland.

## OYSTER-TECTURE



**Figure 46: Oyster-Tecture by Scape**

[Image by Scape, <http://www.scapestudio.com/projects/oyster-ecture/#4>]

A joint effort by MoMA and P.S.1 Contemporary Art center, addressed the effects of future sea-level rise within the New York City Harbor through adaptive strategies.<sup>132</sup> 5 interdisciplinary teams presented their proposals at the Rising Currents: Projects for New York's Water exhibition at the Architecture and Design Galleries at the MoMA, New York City. Guests

<sup>130</sup> "Qunli Stormwater Wetland Park / Turenscape," ArchDaily, accessed February 14, 2015, <http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/>.

<sup>131</sup> "Welcome to Turenscape," Turenscape, accessed February 14, 2015, <http://www.turenscape.com/English/projects/project.php?id=435>.

<sup>132</sup> "Exhibitions," MoMA, accessed December 20, 2014, <http://www.moma.org/visit/calendar/exhibitions/1031>.

to the exhibition were encouraged to comment on the projects as a form of creative collaboration. One of the projects is entitled Oyster-Tecture by Scape.

According to their website, Scape proposes an active oyster culture that “engages issues of water quality, rising tides, and community based development.”<sup>133</sup> The iconic historical culture of oysters as a food system within New York harbor was used as the basic inspirational motivation for the project. Re-introduction of oysters aid in water quality, wave attenuation, creates neighborhood fabrics, and prompts a return to the waterfront. A system of a living oyster reef constructed from a field of piles and a woven web of rope support oyster and mussel growth on a 3-dimensional plane. The relatively low tech and sensitive design solution uses historical cultural references, performative solutions, and promotes human interaction within a coastal environment that addresses sea level rise and climate change.

## **SENSITIVE DESIGN PRACTICES**

Precedent case studies are necessary investigations to determine the most sensitive and appropriate direction for a project. The architectural profession or the role of the architect has changed throughout the history of human civilization. It is important to understand the role of the architect throughout time to alter the perspective of the relationship between architect, client, and user.

In primitive times, the user was the architect. Simple shelters were constructed on the basis of survival. Knowledge of the environment and available resources were the main drivers of architectural units. As nomadic lifestyles were abandoned and civilizations grew, so did the built environment.

The term vernacular is derived from the Latin *vernaculus*, meaning domestic, native, indigenous.<sup>134</sup> Architecturally, designation of vernacular architecture can be applied to represent an indigenous building type derived from specific geographical location and time in history. Vernacular architecture is the result of the representation or infusion of localized needs or function, environmental considerations, local building material, and local culture including traditions, beliefs, and customs. Bernard Rudofsky in *Architecture Without Architects* articulates

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<sup>133</sup> "SCAPE: Oyster-ecture | MoMA Rising Currents," MoMA, accessed February 12, 2015, <http://www.scapestudio.com/projects/oyster-ecture/>.

<sup>134</sup> "Vernacular Architecture – Definition," Vernacular Architecture, accessed March 20, 2014, <http://www.vernaculararchitecture.com>.

the significance that “vernacular architecture does not go through fashion cycles. It is nearly immutable, indeed, unimprovable, since it serves its purpose to perfection.”<sup>135</sup>

Vernacular architecture is defined by G. Arboleda in his website *Ethnoarch* as “an area of architectural theory that studies the structures made by empirical builders without the intervention of professional architects.”<sup>136</sup> Knowledge was passed down orally from generation to generation or from Master Builder to Apprentice, and through practice. This defining role of the architect and the process of attaining the knowledge and skills to be an architect dramatically differs from that of current common practice.

Guidelines and parameters are set by building codes, the client, time schedules, finances, and are swayed by misinformed, misguided, or superficial research, leading to restriction in design creativity and effective solutions. Trends in architectural design also hinder the creativity of the architect, putting too much emphasis on precedents and case studies. Every site, every need is unique and should be treated as such. In *Architecture and the Environment*, Hassan Fathy expresses his personal attitude towards current architectural practice.<sup>137</sup>

*At all costs, I have always wanted to avoid the attitude too often adopted by professional architects and planners: that the community has nothing worth the professionals' consideration, that all its problems can be solved by the importation of the sophisticated urban approach to building. If possible, I want to bridge the gulf that separates folk architecture from architect's architecture. I always wanted to provide some solid and visible link between these two architectures in the shape of features, common to both, in which the people could find a familiar point of reference from which to enlarge their understanding of the new, and which the architect could use to test the truth of his work in relation to the people and the place.*

While the architect possesses a certain degree of expertise in the field, they are not an authority. It is the architect's responsibility to understand the true culture and way of life of the user to create a neutral dialogue, ensuring a more successful design outcome. This holds

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<sup>135</sup> Bernard Rudofsky, *Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture* (Mexico: University of Mexico Press, 1987).

<sup>136</sup> “Vernacular Architecture.”

<sup>137</sup> Hassan Fathy, and Walter Shearer and Abd-el-rahman Ahmed Sultan (eds.), *Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates*, Chicago: The United Nations University, 1986, accessed September 9, 2014, <http://ag.arizona.edu/oals/ALN/aln36/Fathy.html>.

especially true when designing for a unique historical culture. Culture can be understood by connecting on a social, environmental, or technological platform.

*An architect is in a unique position to revive people's faith in their own culture.*

*-Hassan Fathy<sup>138</sup>*

## **CONCLUSION**

In architecture, it is necessary to continually redefine the purpose of design, using every available tool, including: history, culture, climatic data, geography, and available technology help to define the proposed solution. The more successful selected projects incorporate layers of meaning that are appropriate for the site and the user, and are responsive to environmental conditions and factors. These projects also tend to satisfy multiple concerns through a holistic design solution.

Using conclusive analysis from the research into case studies helps to narrow the goal while broadening the perspective.

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<sup>138</sup> Hana Taragan, "Architecture in Fact and Fiction: The Case of the New Gourni Village in Upper Egypt," *Muqarnas* Volume 16 (1999): 69, accessed September 9, 2014, [http://www.academia.edu/5542639/Dpc1577\\_1\\_hassan\\_fathi](http://www.academia.edu/5542639/Dpc1577_1_hassan_fathi).

## CHAPTER 6. DESIGN

### DESIGN PROJECT STATEMENT

The importance of the continuance of Mokauea stems from a rich cultural history, and is validated by continued preservation efforts and a pending nomination for the National Register of Historic Places. Implementation of an architectural solution allowing the traditions, knowledge, and culture of Mokauea to persevere, will be beneficial to both the community and future generations. However, as shown from previous chapters, it is inevitable that Mokauea Island will be consumed by water infiltration due to climate change and sea-level rise.

Climate change is an inevitable phenomenon, affecting communities, ecosystems, and natural and cultural resources. Rising temperatures, glacial melt, decrease in rainfall, increase in extreme weather events, ocean acidification, and sea-level rise are the projected and expected results of climate change. The project focuses on both sea-level rise and storm surge mitigation and the implementation of increased adaptive capacity. Sensitive design strategies are necessary for all types of coastal areas, especially with new development, as decision made today, shape the future.

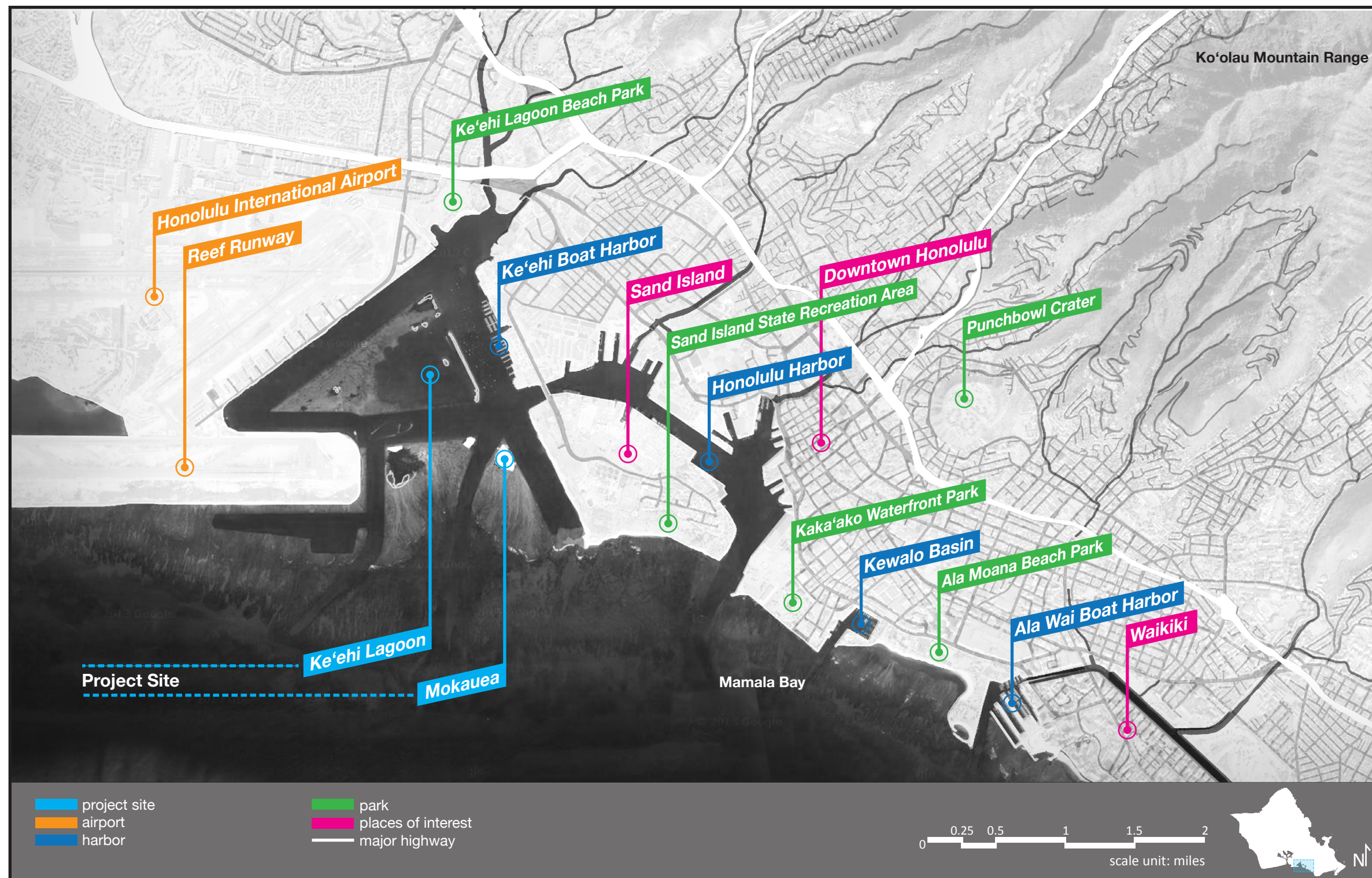
Determination of appropriate design solutions seek to mitigate the negative effects of climate change while taking advantage of the positive effects or opportunities presented. The increase of resilience, adaptive capacity, and decrease of vulnerability allows complete integration and demonstration as a form of coastal adaptation of an area that will be affected by climate change.

Using a framework created by sense of place, the project offers a design solution that is sensitive to Native Hawaiian culture, the existing community, and the environment. A Water Network Experience at Mokauea will be used to bridge the past and the present (both culturally and historically), demonstrate sea-level rise adaptation, incorporate performative elements, and provide public education and awareness, by proliferating the essence of Mokauea. While the project is primarily set by the boundary of Ke'ehi Lagoon, design interventions demonstrate the possibility for replication for other coastal areas of Hawaii and potentially, on a larger global scale. While the components of the system may differ based on location, culture, or community, the impact of sensitive and appropriate design highlights the use of climate change as an inspiration versus a threat

## **SITE ANALYSIS**

The following will illustrate and convey selected site information as additional supplementation to site analysis provided in chapter 2.





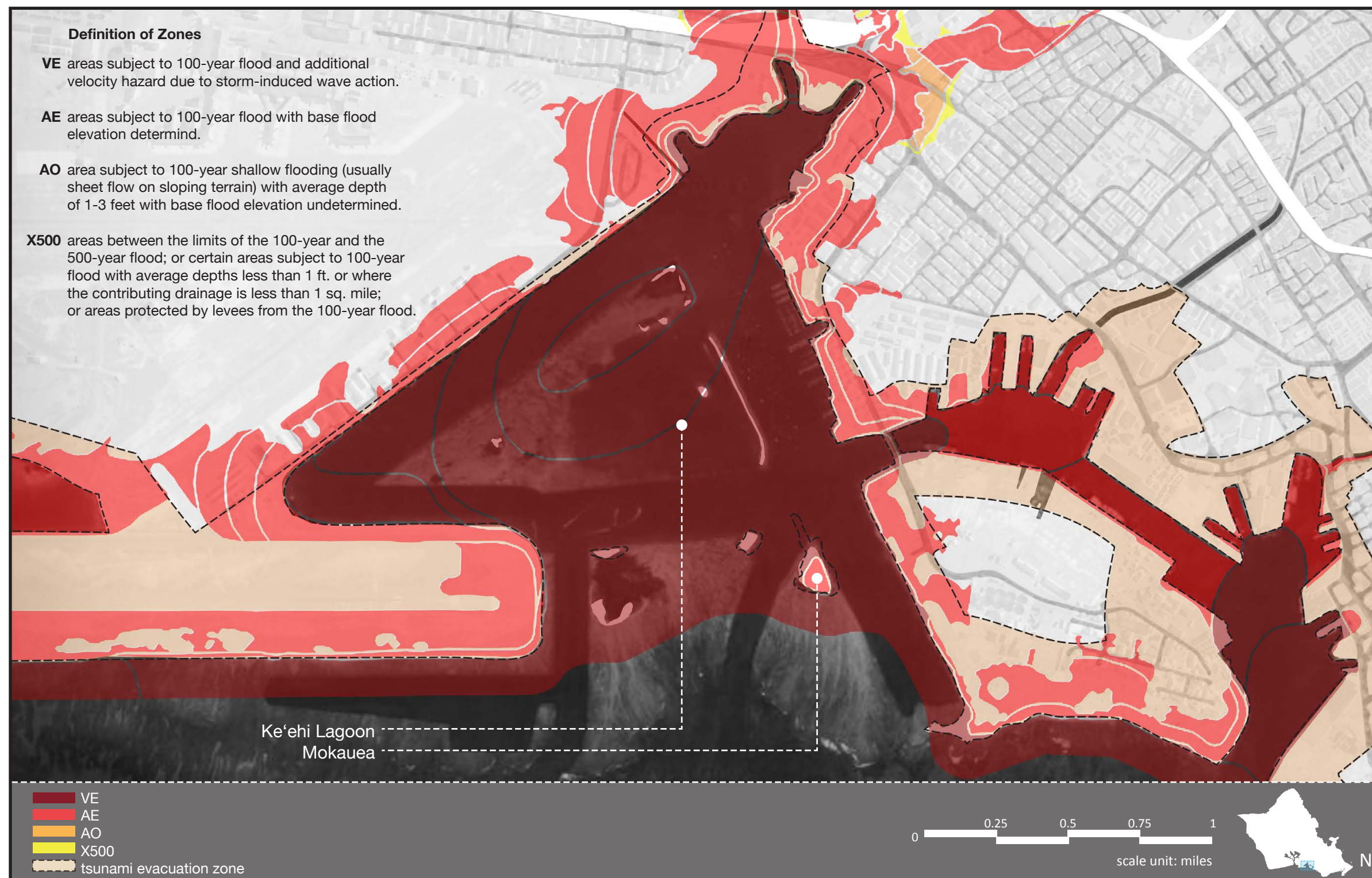
**Figure 47: Project Site**  
 [Image from Google Maps, graphic by author]





**Figure 48: Existing and Permitted Transportation Infrastructure**  
 [Data from HoLis, DPP, C&C of Honolulu, <http://gis.hicentral.com>, graphic by author]

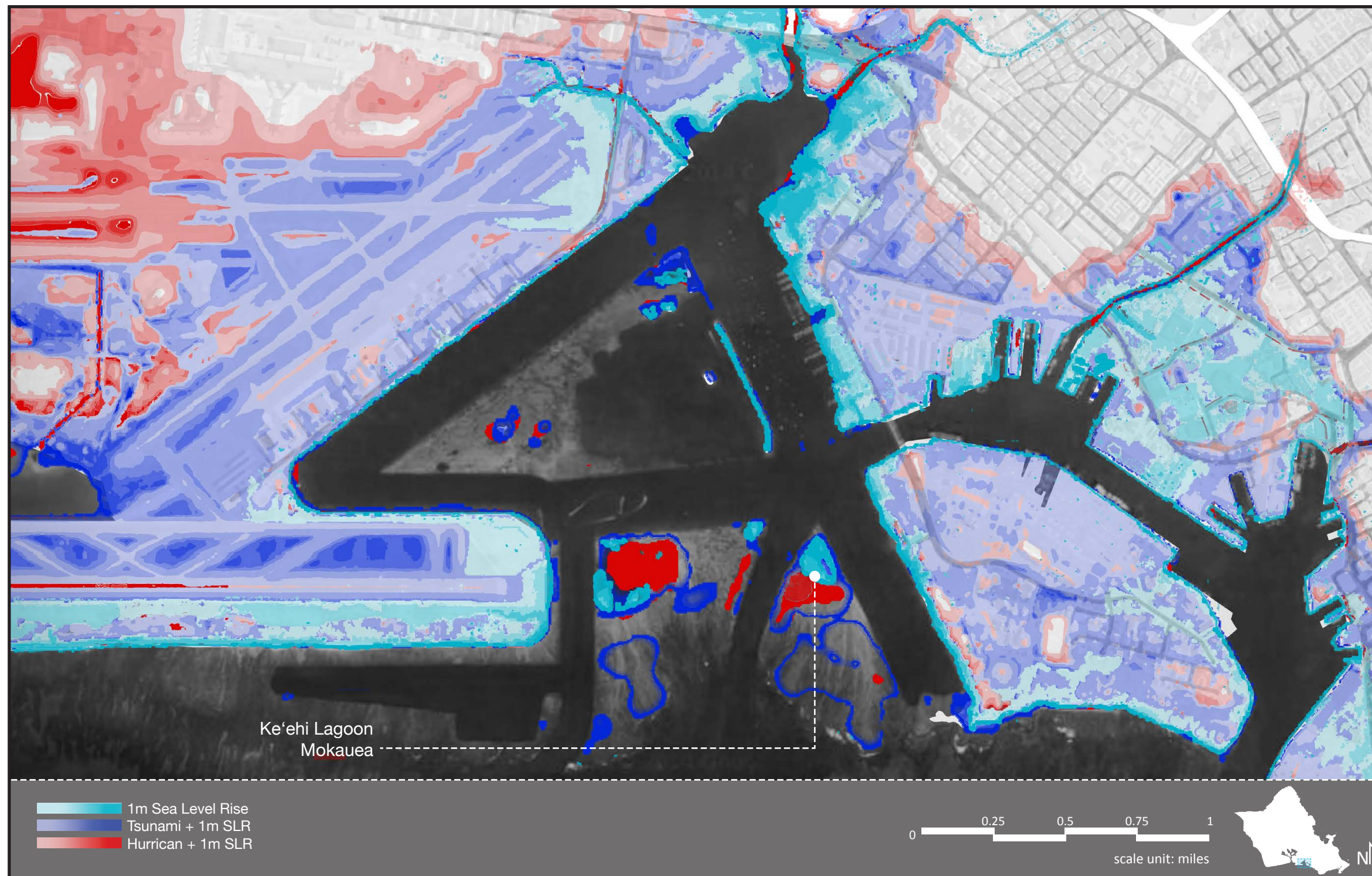




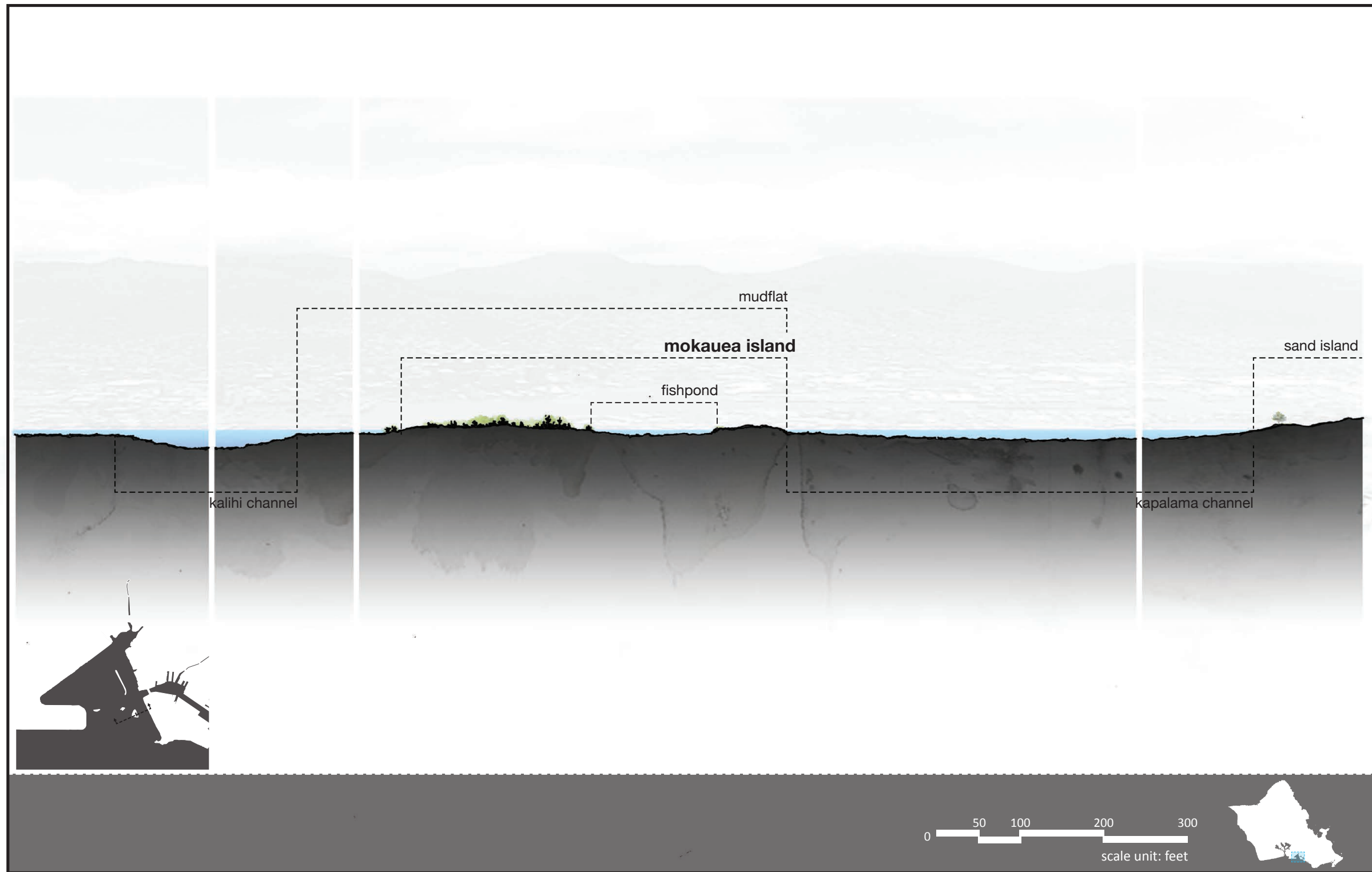
**Figure 49: Current Flood Hazard Zones**

[Data from FEMA, <https://www.fema.gov/floodplain-management/flood-zones#0>, Hawaii State Civil Defense, <http://www.scd.hawaii.gov>, graphic by author]



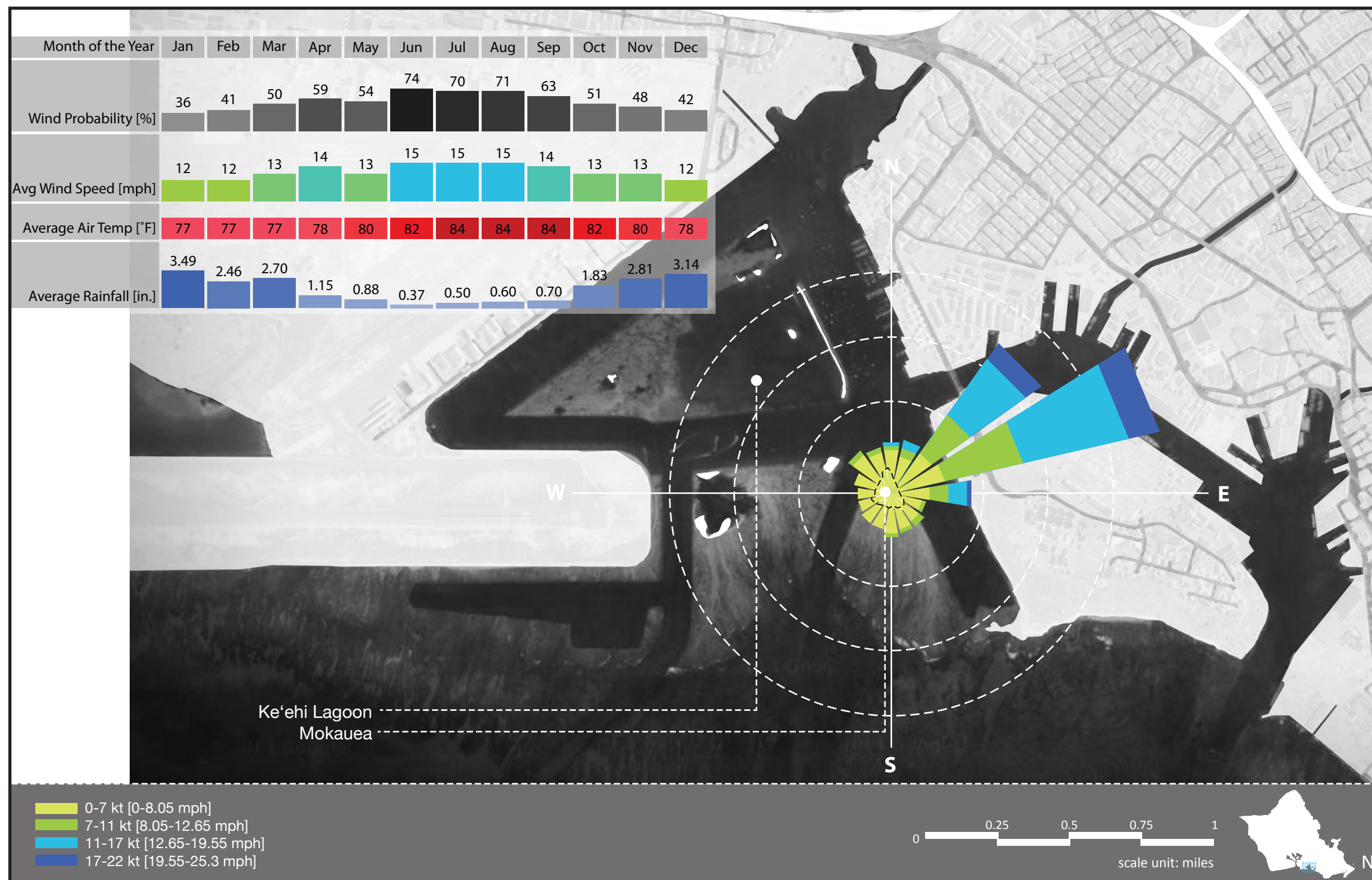


**Figure 50: Projected Flood Hazard Map**  
 [Data from NOAA Coastal Services Center, <http://coast.noaa.gov/slr/>, graphic by author]

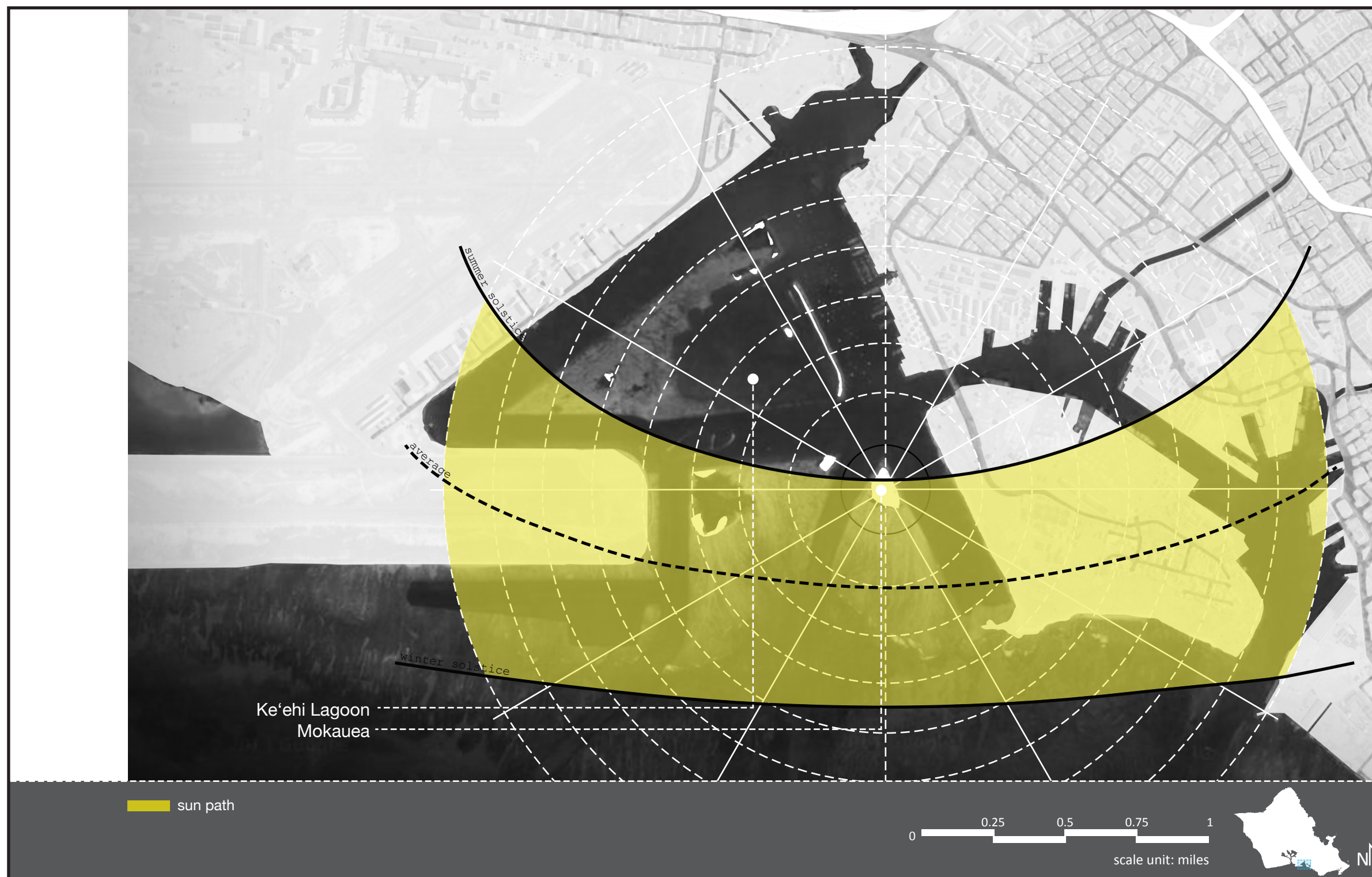


**Figure 51: Section Cut Through Mokauea and Ke'ehi Lagoon**  
 [Data from Continuation of Keehi Lagoon Barge Channel nautical chart by NOAA, graphic by author]





**Figure 52: Site Climatic Data Including Wind Rose Diagram**  
 [Data from National Weather Service, <http://www.weather.gov/climate/index.php?wfo=hnl>, graphic by author]



**Figure 53: Site Sun Path Diagram**  
 [Data from National Weather Service, <http://www.weather.gov/climate/index.php?wfo=hnl>, graphic by author]



## **DESIGN GUIDELINES**

The project will follow a guideline established by the research presented in previous chapters, that provide an understanding of the components of sense of place of Mokauea and Ke'ehi Lagoon. The formulation of a perspective lens offers insight into design appropriate and design sensitive solutions, and is produced by understanding culture, community, and the environment. As shown in previous chapters, sense of place is a statement of being, which incorporates: identity, place, and relation to the environment that is derivative of historic cultural values and practices, and influenced by the environment. Through research as illustrated in previous chapters, it is possible to create a matrix of design influencing components in order to create multiple layers of understanding and meaning which will translate or be addressed within the architectural design solution. The conclusive matrix as illustrated in Figure 46, compiles all chapter conclusion diagrams, highlighting the organizational method of the research translated into design to create a comprehensive understanding of sense of place that can be used as a device to embrace the dichotomies of past and present, physical and spiritual, and nature and humans while creating self, community, cultural, and geographic identity.

## **PROJECT PARAMETERS**

### **Water Intimacy**

Mokauea and Ke'ehi Lagoon are water-based locations. Historical and existing conditions and significance prove a strong relationship to water and in specific the ocean. The continued celebration of water will be used to re-invigorate human and nature integration to create an intimate relationship. The use of marine navigation will allow users to be physically connected to the elements creating a non-tangible interconnected atmosphere. Walkways will also take advantage of the relation to water as experiential. Sea level rise as a result of climate change will cause dramatic changes to Mokauea and Ke'ehi Lagoon providing an opportunity to embrace the perceived negative effects.

### **Time Line**

Climate change data is gathered from both the IPCC and NOAA reports. Sea level rise projections based on time, as in the IPCC reports, include a large margin for error, determined by multiple variables.

Increase in sea level rise through time will be determined and displayed based on NOAA reports and therefore relies not on time, but solely on sea level rise or SLR.

The 65-year lease of Mokauea by the State of Hawaii and to the Mokauea Fishermen's Association will expire in 2043. The design and its implementation will be respectful of the lease agreement, accommodating for existing use.

### **Existing Plans**

As detailed in chapter 2, both the Harbor Masters 2020 Master Plan and Department of Land and Natural Resources have proposed development projects in or near Ke'ehi Lagoon. The design proposals will be integrated into the design as to not replace any of the existing plans, but to be integrated and interconnected as a seamlessly structured system.

### **Sustainability**

Design interventions will practice sustainable practices including but not limited to: material choices, construction methods, energy production and use, and employment of sensitive practices when dealing with natural resources. As discussed in Chapter 1, Native Hawaiian Culture involved an intimate relationship with nature and as shown through the ahupua'a system held an expertise in resource management, being stewards of the land.

### **GOALS**

- Become an integral element within the community
- Re-invigorate ecological systems
- Improve quality of life
- Create a sense of place
- Incorporate Responsive | Performative design
- Provide an educational platform

### **PROGRAM | FUNCTION**

As mentioned above, the goal of this project is to develop a water network experience using strategies stimulated by climate change ranging from retreat, protect, and adapt. The design for the system incorporates all three concepts, appropriated by site context. The system performs as a network of engagement within the site offering an intimate connection with the ocean, providing educational platforms, introducing and integrating performative design, and is based on climate change and sea-level rise. By employing sensitive decision making in regards to culture, the built environment, and nature, it is possible to create an attachment and appreciation for the surrounding environment, allowing awareness to the impact to the surrounding environment in an effort to practice sensitive design for future generations. This can be achieved through the development of environmentally responsive, culturally derived, and

place appropriate solutions. As no culture is ever static the aim of the proposed design project is not a museum, nor is it to replicate the past.

## **Organization**

There are two organizational systems that will help structure the design. The first is based on a functional or thematic representation of the Water Network Experience and will be referenced within the subsequent detailed zone section.

### *Functional | Thematic Identification*

The functional or thematic components include: ecology, sea-level rise, storm surge mitigation, history, culture, and human and nature integration, and were derived from design research as discussed in previous chapters, guided by sense of place. Figure 55 represents and illustrates a physical thematic overlay of the proposed site map informed by the conclusion diagram matrix in Figure 54. It is important to note that most components have a dual thematic attribute.

The second organizational system is based on a programmatic approach to deliver information about the details of the site. The program as expressed below, is organized by zone.

### *The Zones*

Each zone works as a vital component of a larger system, integrating sea-level rise and offering storm surge mitigation and protection measures. Inspired by Hawaiian culture, the system enables the engagement between users and the site, working around the principles of sense of place. Zone design and grouping, pictured in Figures 57 and 58, are influenced by location and opportunity, and serves to enhance both the human experience and the natural environment.

#### **Zone 1 : Reef Rehabilitation**

This zone encompasses the natural protective capabilities of the existing coral reef. Zone 1 is considered to be the first line of protection for Ke'ehi Lagoon. Although most of the reef system in this area is no longer thriving, the skeletal remnants, including the reef crest, provide both a habitat for marine animals, and perform as wave attenuators in the face of storm surges. According to benthic mapping of the Ke'ehi Lagoon area, a section of the reef crest is not complete, creating an opportunity to experiment with reef rejuvenation.

#### Zone 2 : Living Island Barrier

Used to develop a relationship between the community and the ocean, by providing a platform for connectivity. Location of islands are determined from the mud flat edge found on historic maps of the Ke'ehi Lagoon area.

Oyster reef formation: The makai side of the barriers will be used to grow Native Hawaiian Black-lip Pearl Oysters to be used as storm surge protection, to increase biodiversity, to improve water quality, and a possible food resource.

#### Zone 3 : The Experience

Zone 3 incorporates the historic significance of the Ke'ehi Lagoon area including fishponds and the relation to the sea. This area will house an information center and a walkway system to provide an educational experience. The design will address the natural beauty of the area, the historic and cultural significance of the area, sea level rise, and include sustainable interventions. The zone will be further broken down into 3 distinct components titled: Mokauea, Kahaka'aulana, and Mangrove Trail.

1. Mokauea will serve as the hub of open water activity. A complex that includes an information center, a canoe viewing platform, pond viewing platform, and a viewing tower will be used to educate visitors on the cultural importance and historical significance of Mokauea. An active fishpond, walkways, and man-made islands will also be incorporated.

2. Kahaka'aulana will be a smaller rest space and information center highlighting the importance of the tidal island as the home to Kahuna well versed in navigational skills.

3. The Mangrove Trail will use a network of walkways to engage the user with the natural environment. The trail will also be used to educate the public on the negative impacts of invasive species.

#### Zone 4a : Terraced Living Wall

The Airport side of the Lagoon is vulnerable to sea level rise. A terraced living wall will be implemented to help mitigate the effects of water infiltration to the airport, while providing a habitable area for recreation.

#### **Zone 4b : Constructed Salt Marsh**

The Sand Island side of the lagoon will be transformed into a combination of park and wetland areas to increase engagement within the natural environment, embrace sea-level rise, and assist with storm surge mitigation.

#### **Zone 4c : Floating Pier and Dock**

The existing area of Ke‘ehi Boat Harbor is succumbing to the effects of sea-level rise and will need an intervention for functional continuance. A floating boat dock system will be implemented to serve existing needs and accommodate for sea level fluctuations.

#### **Access**

Access to the site will rely upon the existing transportation matrix including, personal vehicular, public transportation, and bicycle, as illustrated in Figure 48. The incorporation of a shuttle to serve the site where public transportation does not currently exist will aid in accessibility.

#### **Navigation**

Navigation through the site will be done primarily by self-powered and self-guided canoe or boat. This chosen method of transportation allows users to navigate freely throughout the site, use traditional methods of navigation, and increase intimacy with the natural elements. All canoe and boat docks will be ADA accessible. There will be scheduled guided tours done by both group canoes, and a larger boat ferry.

#### **Native plants**

Native Plants will be used on the site and will be selected based on natural coastal habitat and saltwater tolerance. Native plant restoration allows for the education and species regeneration and proliferation. Native plant restoration is occurring on many parts of the island in different ecological zones. For example, during a visit to Kualoa Ranch, David Morgan, co-owner, spoke of a recent project that employed a yearlong eradication of an invasive tree species. Although it is a continual effort, all of Kualoa Ranch is trending toward Native restoration including stream rehabilitation and water shed conservation. The importance of retaining Native Hawaiian Cultural values and practices is evident and being perpetuated through the exploration of different avenues.

Hui Kū Maoli Ola or transforming land back to ‘āina is a resource of Native Hawaiian Plants, continuing the efforts to progress knowledge of traditional cultural practices and their

meanings by educating the public about the use of Native Hawaiian Plants. Hui Kū Maoli Ola was founded in 1999 by Rick Barboza and Matt Schirman. An initial interest in Native Hawaiian bird species led to the realization that it stemmed from the destruction of their native habitat. Through their efforts, they have increased the number of available native Hawaiian plant species from 5 to over 200.<sup>139</sup> The nurseries aim is for the insurgence of education and accessibility of Native Hawaiian plants as described in their mission statement:

*Hui Ku Maoli Ola is an organization dedicated to the perpetuation and preservation of Hawaii's natural history and culture. By integrating education, the propagation of native Hawaiian plants, and through quality restoration and landscaping services, we are making improvements to and increasing public appreciation for the unique natural environment and cultural history of our precious island home.*<sup>140</sup>

Every plant has a mo'o or story. And the olelo or language is an important facet within Native Hawaiian culture as well as the plants that inhabit the islands. As in place names by Mary Puukeni, a name is not just something pulled out of thin air. There is meaning behind it, describing a story of origin, or importance, or the essence of the plant. Pua is the nursery manager at Hui Ku Maoli, and hold degrees in Hawaiian studies and botany from the University of Hawaii. On a visitation to the nursery Pua explained that there are dual meanings and dichotomies represented within plants and their origin and meaning. There is a Native Hawaiian Plant called the Aweoweo. There is also a fish called the aweoweo. Within the Kumulipo as mentioned in chapter 1, the intrinsic relationship between sea and land is represented in a dualistic creation. When the fish was not available for prayer offerings, the plant is used as a respectable replacement, as the crushed leaves of the aweoweo plant resembles the smell of the aweoweo fish. Another example involves the Native Hawaiian staple, Kalo or taro. A legend states that if the head of a fish is cut off and the body planted in the ground it will grow. The symbolic interconnectedness of land and sea is once again referenced within Native Hawaiian Culture.

The revitalization of the presence of Native Hawaiian plants is used to pass down knowledge and better understand the origin of Native Hawaiian Culture.

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<sup>139</sup> "Company History," Hui Kū Maoli Ola, accessed February 18, 2015, <http://www.hawaiiannativeplants.com/company-history/>.

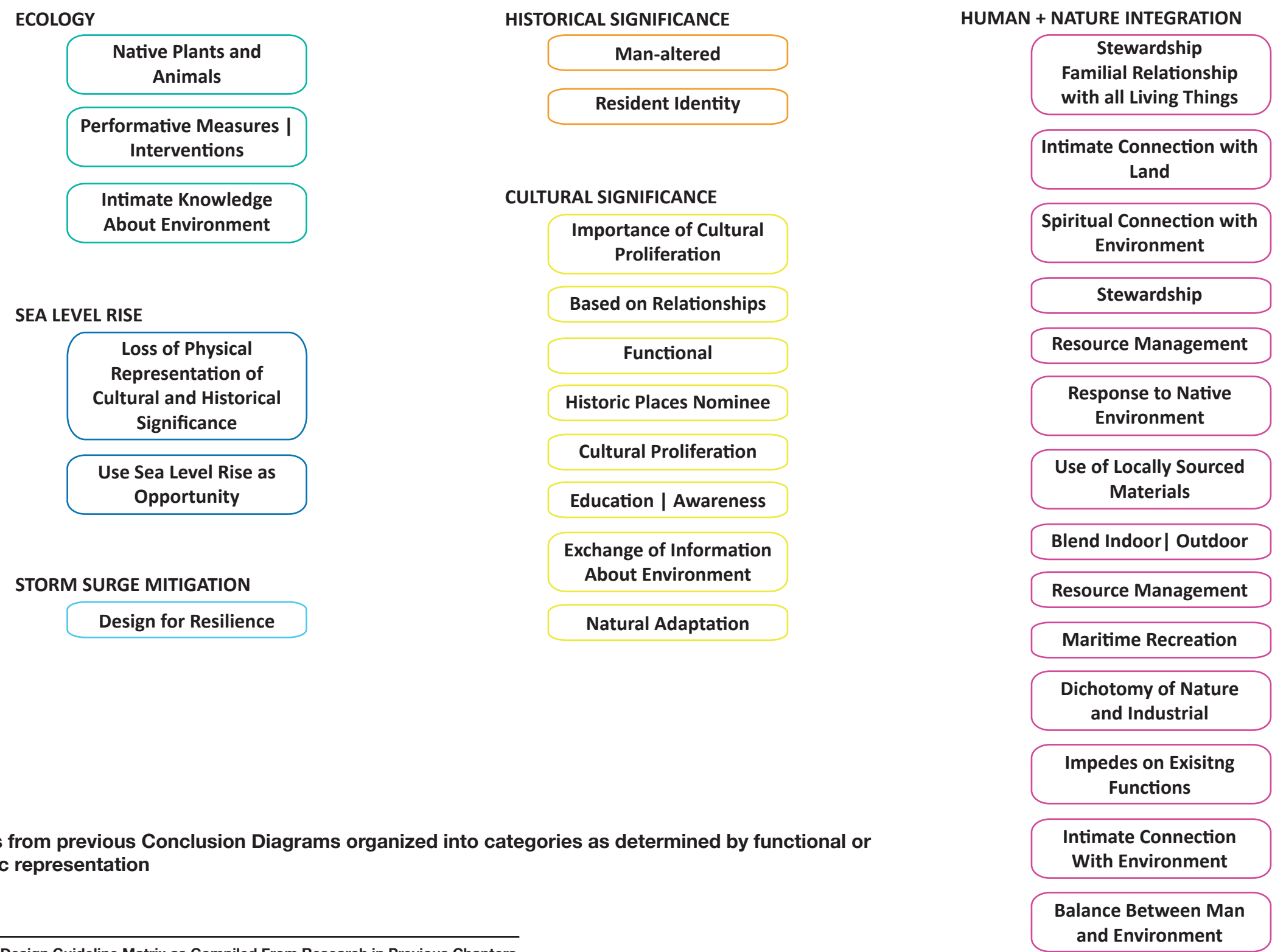
<sup>140</sup> "Our Mission," Hui Kū Maoli Ola, accessed February 18, 2015, <http://www.hawaiiannativeplants.com/our-mission/>.

A recent visit to Kahumana Community in Waianae exhibited a resurgence of the farming community. According to their website, the mission of Kahumana is “ to co-create a healthy, inclusive and productive farm-based community with homeless families, people with disabilities and youth,” using a historical cultural dependence and relationship with agricultural practices to offer people sustainable ways to live, think and feel.<sup>141</sup> The integration of modern forms of aquaponics are used to grow taro, allowing sustainable productivity of a Native Hawaiian plant facing the challenges of increased temperature and loss of natural water resources. Kahumana is an example of the use of traditional Hawaiian cultural practices to heal through the celebration of the natural beauty and resources of Hawaii, embracing the cultural environment, and inspiring individuals, communities, and beyond.

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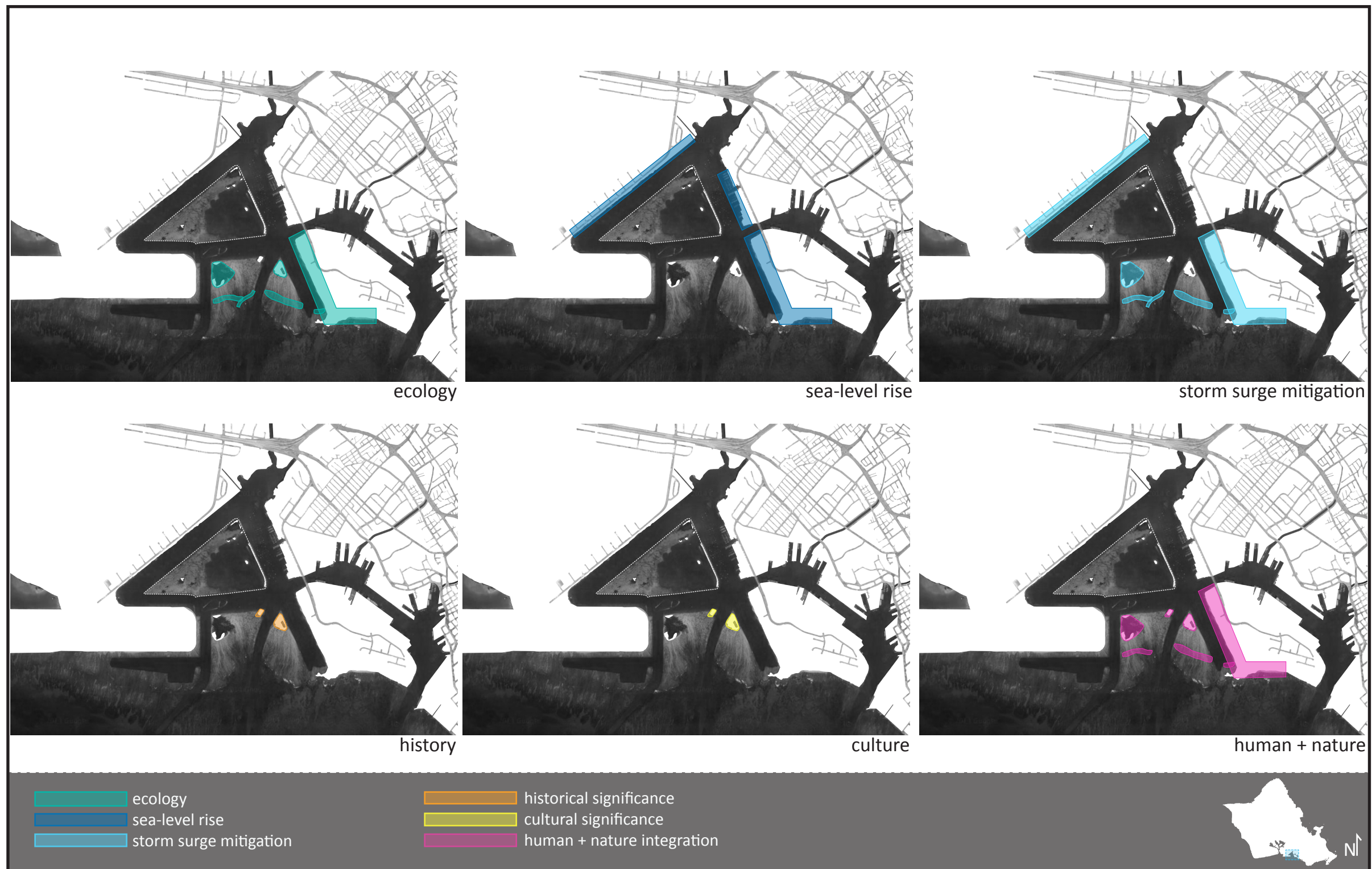
<sup>141</sup> “Home Page,” Kahumana Community, accessed February 20, 2015, <http://www.kahumana.org>.



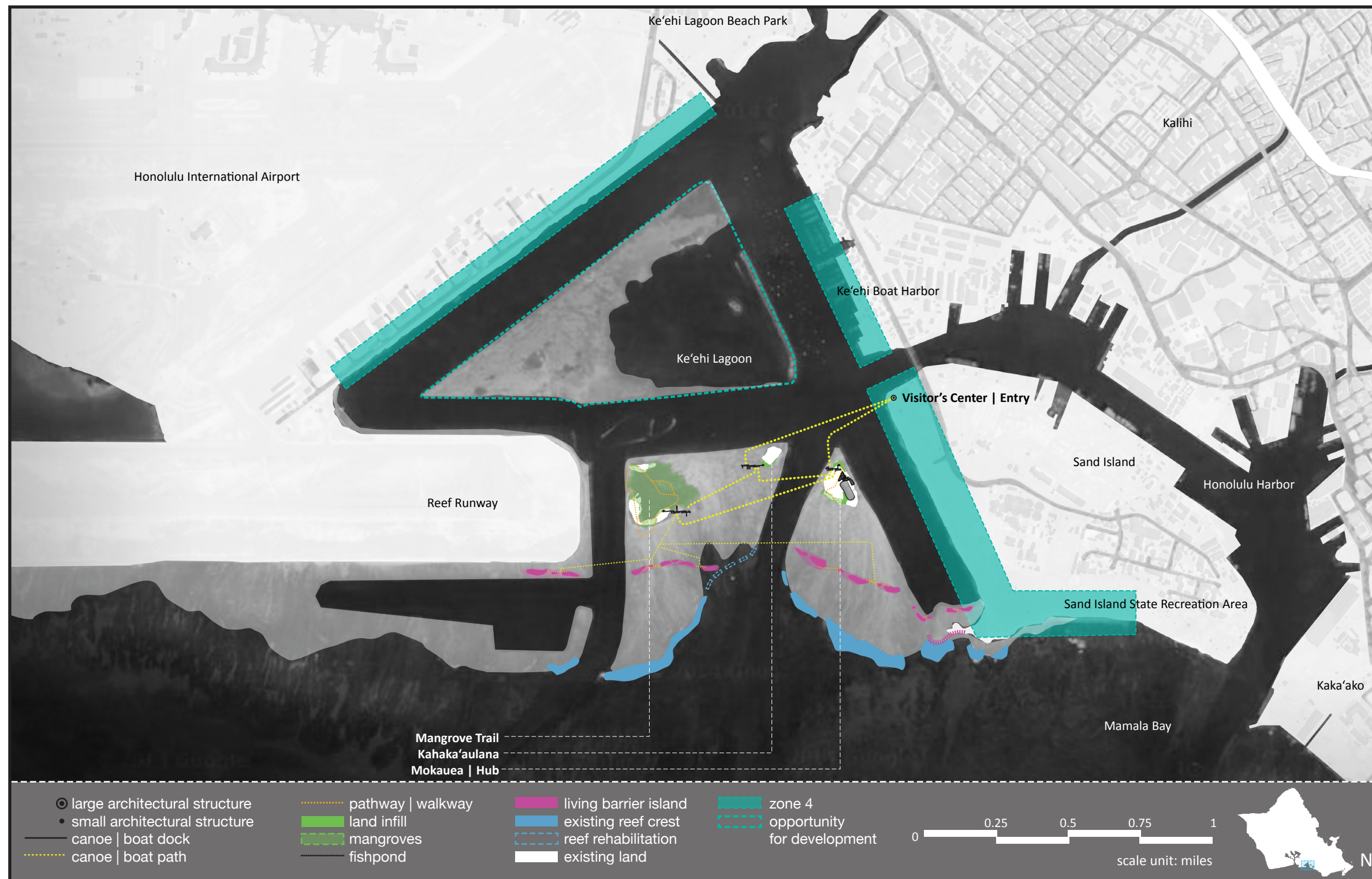


Impacts from previous Conclusion Diagrams organized into categories as determined by functional or thematic representation

Figure 54: Design Guideline Matrix as Compiled From Research in Previous Chapters  
[Graphic by author]

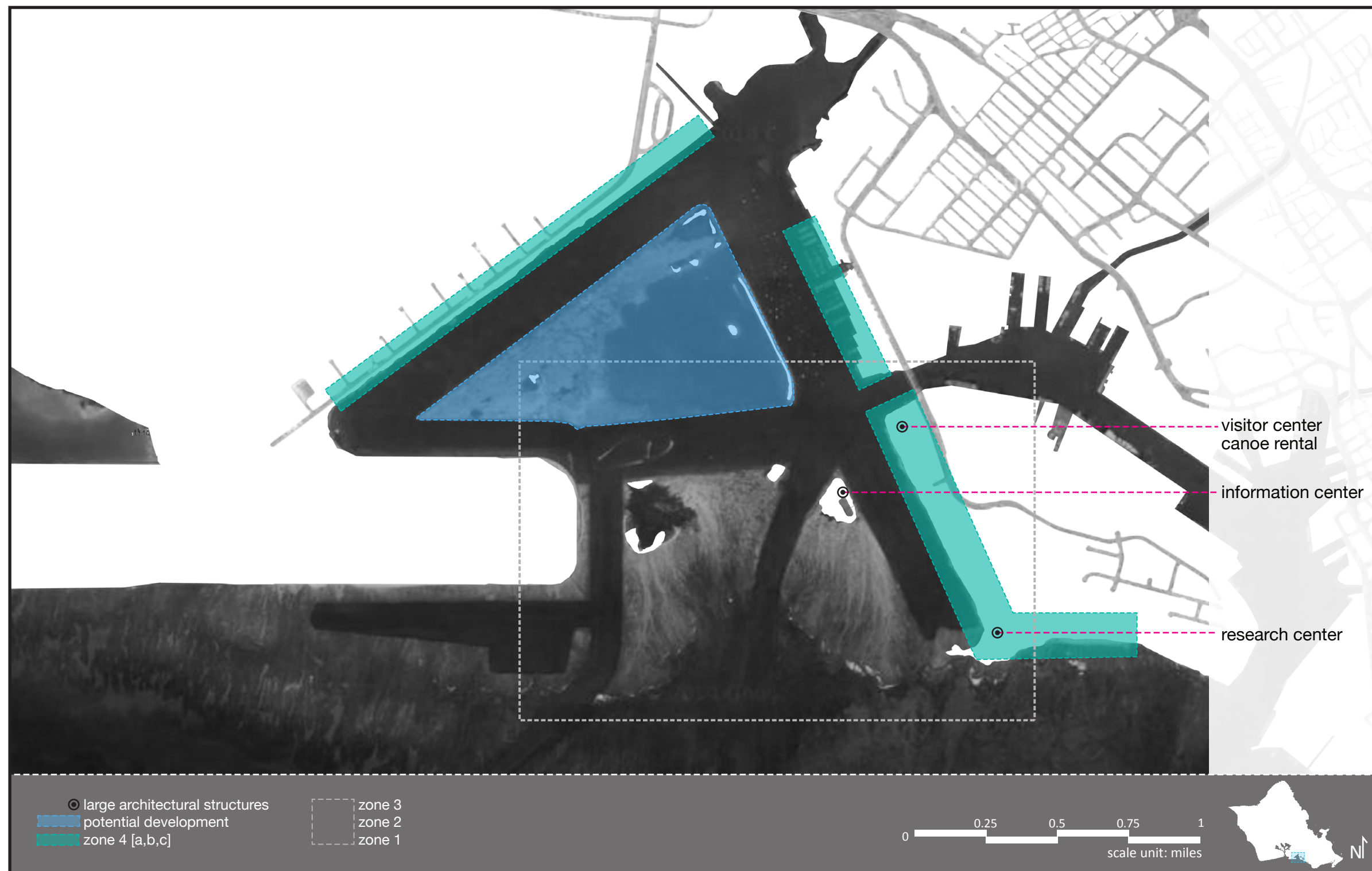


**Figure 55: Functional | Thematic Organization**  
 [Image from Google Maps, graphic by author]

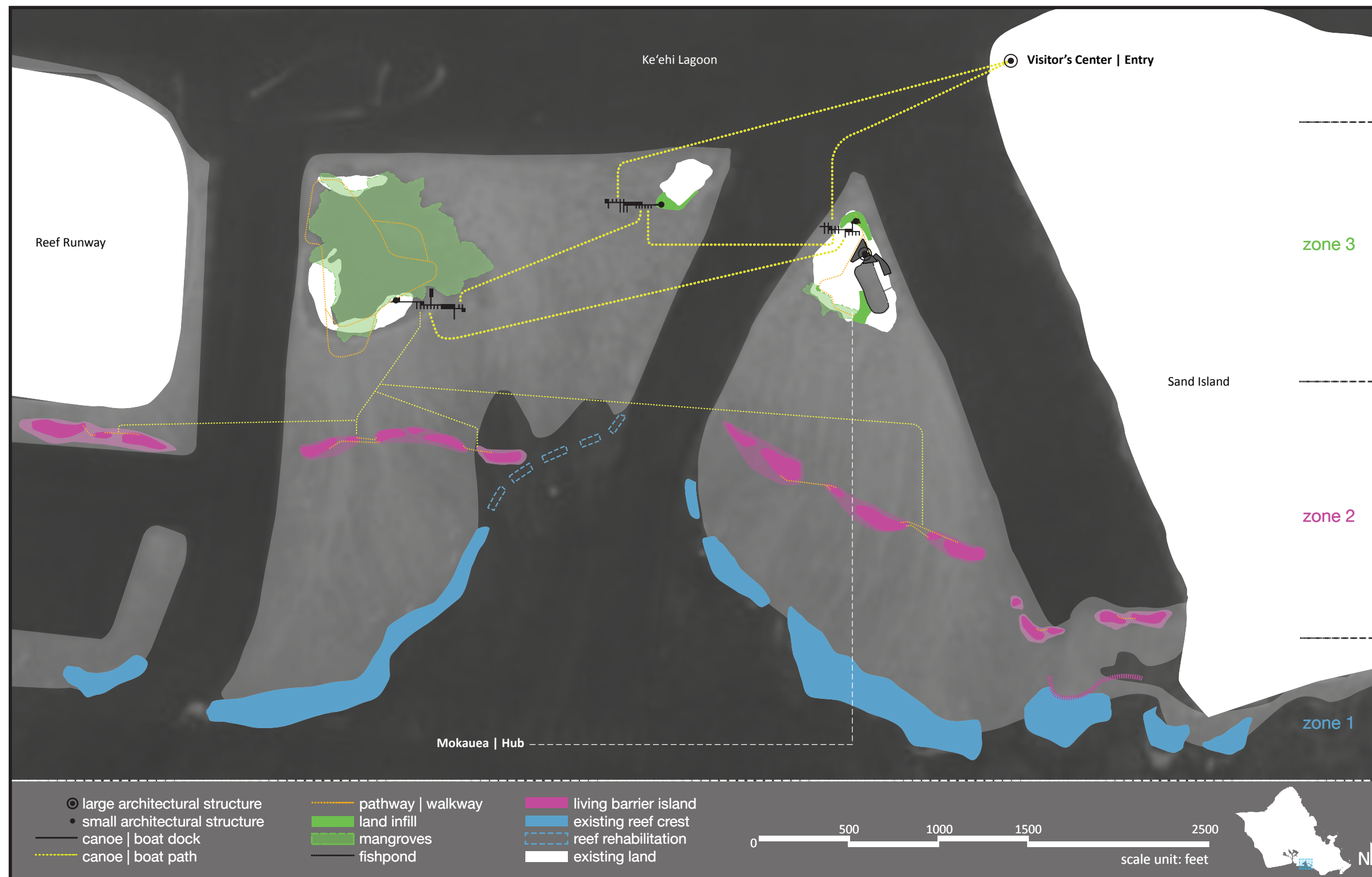


**Figure 56: Site Master Plan of the Water Network Experience**  
 [Image by Google Maps, graphic by author]





**Figure 57: Zone 4 Organization**  
 [Image from Google Maps, graphic by author]



**Figure 58: Zones 1, 2, 3 Organization**  
 [Image from Google Maps, graphic by author]



## Ground Cover



'ākulikuli



hinahina kū kahakai



'ilima papa



nehe

## Grass



kawelu

## Water



'ae 'ae

## Shrub



naupaka kahakai



'ohai



'ūlei



kona loulu

## Palm

## Tree



hala



hau



kou



milo

note: Plant selection based on site visit to Hui Kū Maoli Ola, Salt and Wind Tolerance of Landscape Plants for Hawai'i by CTAHR at the University of Hawai'i, and the Hawaiian Native Plant Gera by UH Botany, and determined by salt tolerance and coastal habitation. All plants are native or endemic to Hawai'i.

### Figure 59: Native Plant Selection and Inclusion

[Data as noted from above, images courtesy of CTAHR, <http://www.botany.hawaii.edu/faculty/carr/natives.htm>, graphic by author]

## **DETAIL SITE MAP**

While all zones are designed according to climate change, and inspired by Native Hawaiian cultural beliefs and values, every component of the system has a different focus and responsibility. The following section highlights the governing influence for design intervention.

The Detail Site Map Section will include:

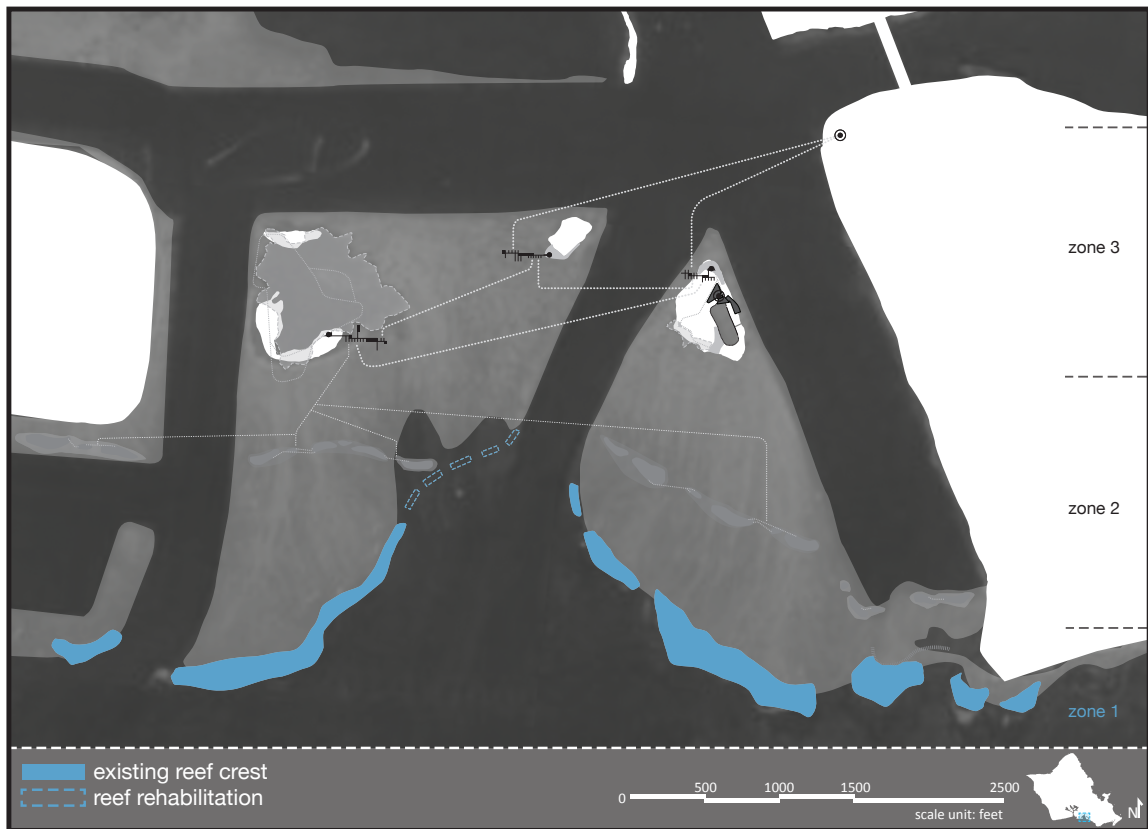
- Zone 1
- Zone 2
- Zone 3
- Zone 4

Zones are organized by physical location, running in the makai to mauka or south to north direction. The designation of zones help to further explain in detail the elements of the Water Network Experience system and its relation to the components of sense of place.

Subsequent Sections will include selected architectural details.



## Zone 1 : Reef Rehabilitation



**Figure 60: Zone 1, Reef Rehabilitation**  
[Image from Google Maps, graphic by author]

As discussed in chapter 1, in the Hawaiian Kumulipo, the coral polyp was the first living creature to be born. Native Hawaiians understood the importance of coral reefs as a primary source of life. Using historic reverence and modern day technological applications, a reef rehabilitation area will be implemented.

The entire south coast of Oahu is known as Maunalua Bay, and stretches from Koko Head westward to Kahe point. Most of the current shoreline is artificial, developed for commercial or urban activity. Maunalua bay is one of the most protected shorelines in the State due to a large expansive fringing coral reef. At Ke‘ehi Lagoon, this reef extends for approximately two miles. This reef flat has been dramatically altered due to the dredging of channels and a series of seaplane runways. Historically, the reef flat offered both a physical connection to tidal islands within Ke‘ehi Lagoon and a healthy environment for marine life. The

dredging of Ke‘ehi caused extensive silt build up on the reef killing many specimens. However, recent site visits show new growth of coral structures and presence of marine life.

According to NOAA’s Coral Reef Conservation Program, the biodiversity of reef systems is more diverse than any other ecosystem on the planet, supporting over 800 hard coral species and 4,000 species of fish. 25% of the world’s fish biodiversity are associated with coral reefs.<sup>142</sup> Reef rehabilitation near the existing reef crest at Ke‘ehi Lagoon will encourage active marine environment while serving as storm surge mitigation.

90% of wind driven wave energy is absorbed by coral reefs, exercising prominent storm surge mitigation abilities.<sup>143</sup> The reef helps to protect shorelines from currents, waves, and storms, helping to prevent property damage, excessive water inundation, and coastal or shoreline erosion.

Ocean acidification due to climate change threatens coral sustainability. The rehabilitation area can be used as an experimental laboratory to determine appropriate actions in order to adapt to changing water conditions. Economically, it may also be used as a natural and renewable lime resource, posing as a coral farm. In the Solomon Islands, through the national betel nut coral lime trade, the economic value of coral lime is equivalent to the economic value of reef fish.<sup>144</sup>



**Figure 61: Examples of Reef Rehabilitation: Biorock and the RIMBA Project**

[Images by Biorock <http://www.biorock.net>, and RIMBA, <http://www.ulule.com/rimba-project/>]

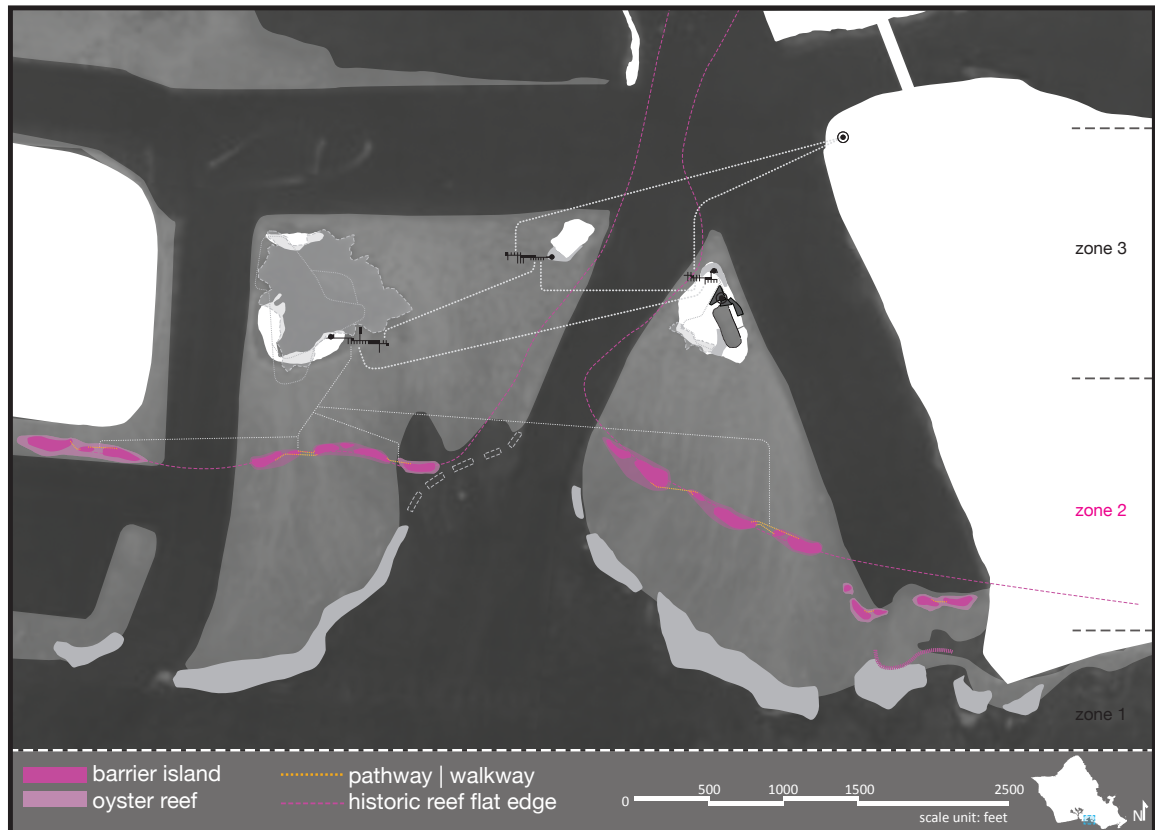
<sup>142</sup> “About Corals,” Coral Reef Conservation Program, accessed December 12, 2014, <http://coralreef.noaa.gov>.

<sup>143</sup> *Ibid.*

<sup>144</sup> Albert, J.A., Trinidad, A., Boso, D., and Schwarz, *Coral Reef Economic Value and Incentives for Coral Farming in Solomon Islands, Solomon Islands*, Policy Brief, Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems, 2012, accessed November 18, 2014, [http://pubs.iclarm.net/resource\\_centre/WF\\_3163.pdf](http://pubs.iclarm.net/resource_centre/WF_3163.pdf).

Currently, the reef crest at the opening of Ke‘ehi Lagoon is not complete. Referencing the Benthic Map in chapter 2 offers a suggestive location for reef rehabilitation and growth and is illustrated in Figure 60. The addition or implementation of a reef rehabilitation area or zone offers a performative attribute to the area, increasing biodiversity, storm surge protection, and offering a natural resource for economic gain, under the physical and symbolic significance within Native Hawaiian culture.

### Zone 2 : Living Island Barrier



**Figure 62: Zone 2, Living Island Barrier**  
[Image from Google Maps, graphic by author]

The Living Island Barrier zone offers an area of interface between the raw power and natural environments of the elements, using a combination of artificial islands and an oyster reef.

## Oyster Reef



Oysters are bivalve mollusks who have the ability to: clean water through a natural bivalve system, create oyster reefs that support biodiversity and offer storm surge protection, serve as a food source, and as a commodity (oyster meat and pearls).

A pearl is created from a natural immune response to foreign particles. As sand, organic debris, or parasites enters the oyster, nacre is produced, coating the particle isolating the invasive particle and irritation. Oysters that produce pearls have been prized historically, and the Hawaiian black-lip pearl oyster produces the infamous Tahitian pearl, and is considered to be of highest quality.

**Figure 63: Wild Black Lip Pearl Oyster Ahe Atoll, French Polynesia**

[Image by thelovelyseas on FoodBoard, <http://food.browzen.com/p/PV1tVm>]

The Hawaiian black-lip pearl oyster or *Pinctada margaritifera* is endemic to the Northwestern Hawaiian Archipelago species, originating from tropical Indo-Pacific regions.<sup>145</sup> Although generally uncommon to the main Hawaiian Islands, it is reported that in 1930, 310 oysters were introduced to Kaneohe Bay from Pearl and Hermes Reef. Research and analyses conducted in Kaneohe Bay provides conclusive evidence that the Black Lip Pearl oyster lives in

<sup>145</sup> S. Ku'ulei Rodgers, Neil A. Sims, Dale J. Sarver, Evelyn F. Cox, *Distribution, Recruitment, and Growth of the Black-Lip Pearl Oyster, Pinctada margaritifera, in Kāne'ohe Bay, O'ahu, Hawai'i*, Pacific Science (2000), vol. 54, no 31-38, accessed January 4, 2015, <https://scholarspace.manoa.hawaii.edu/bitstream/handle/10125/1596/v54n1-31-38.pdf?sequence=1>.

natural habitat that ranges from 0-3m deep.<sup>146</sup> The proposed area for the oyster reef ranges from 1-3m in depth.

A final assessment report in A Pearl Farm and Pearl Oyster Reef Reseeding Project in The Reef Runway Borrow Pit in Keehi Lagoon, Honolulu, Oahu, prepared by Black Pearls, Inc. in 2001 included data from comprehensive research of the Keehi Lagoon and Airport Reef Runway focusing on favorable conditions for the farming of Hawaiian Black-Lip Pearl Oysters.<sup>147</sup> The implementation of an oyster farm used as a food source and harvesting pearls, provides economic opportunity.

Overall water quality has been threatened by the nearby wastewater treatment plant as well as pollution from the Honolulu Harbor. According to National Geographic, oysters are able to filter as much as 50 gallons of water a day per oyster.<sup>148</sup> Oysters are filter feeders, and are able to remove nitrogen rich plankton and organic particles from the water column, improving water quality.

As mentioned earlier for invasive species removal and ecological rehabilitation efforts, Kualoa Ranch is a demonstration of oyster farming, although they are using the Pacific oyster. According to Dave Morgan, co-owner of Kualoa Ranch, although the initial driving factor was purely economic, the implementation of oyster farming has created other opportunities in relation to education and awareness. Near the oyster farm, Kualoa has created a demonstration of an original fishpond using oyster shells. They are also using the oyster shells as ground cover in muddy areas.

The use of a Native oyster provides the opportunity to aid in water quality, providing storm surge mitigation, increased biodiversity and marine habitat, restoring a native species, and possible economic opportunity.

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<sup>146</sup> *Ibid.*

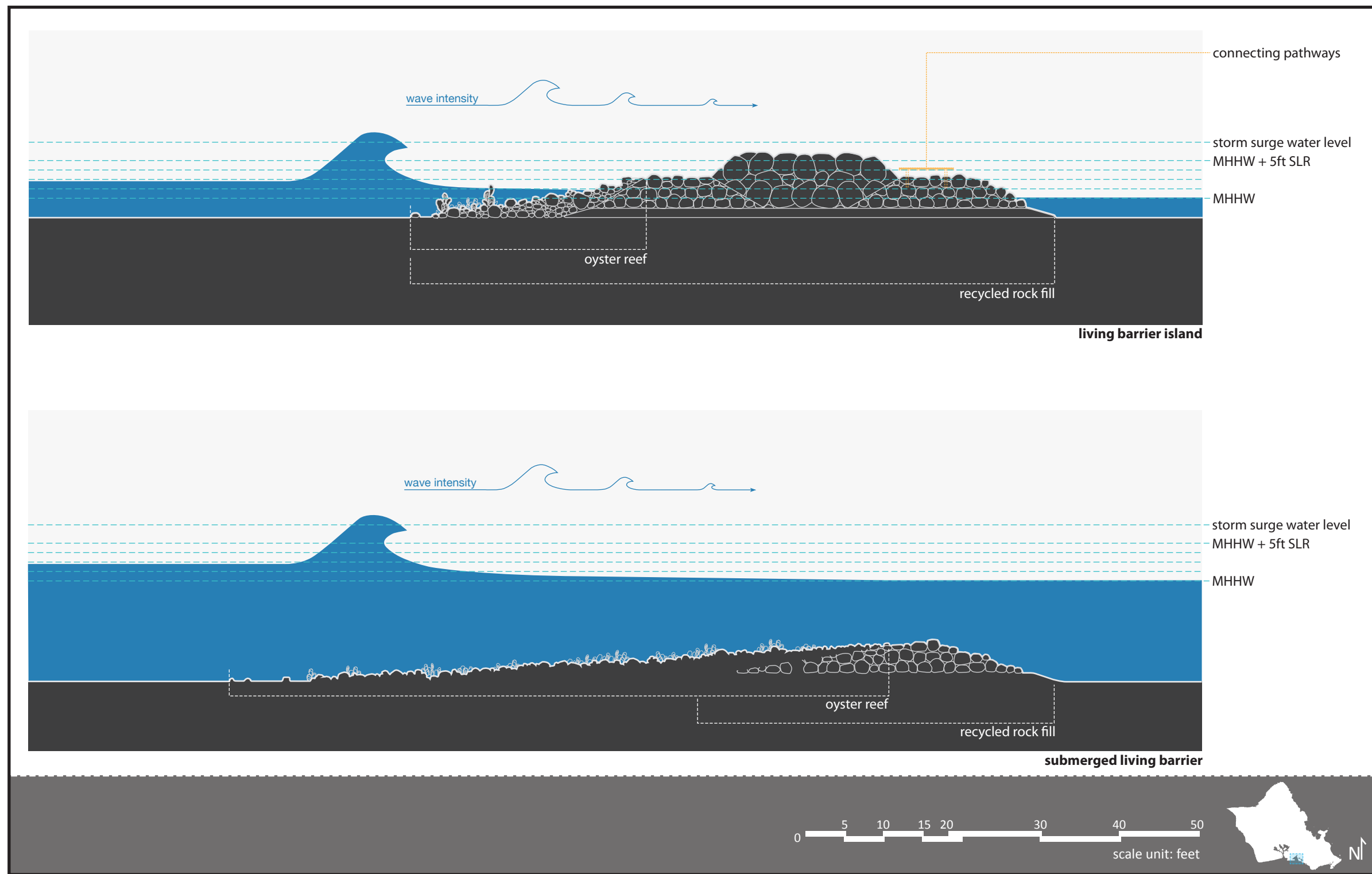
<sup>147</sup> Black Pearls Inc., *A Pearl Farm and Pearl Oyster Reef Reseeding Project* (Hawaii: Department of Land and Natural Resources, 2001), accessed December 12, 2014, [http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf).

<sup>148</sup> Dan Stone, "Conservation on the Half Shell: Oysters Help Clean New York's Dirty Harbor," *National Geographic Magazine*, June 7, 2013, accessed December 12, 2014, <http://voices.nationalgeographic.com/2013/06/07/conservation-on-the-half-shell-oysters-help-clean-new-yorks-dirty-harbor/>.

### *Islands*

Man-made islands will be constructed inward of the natural reef crest. The location of these islands follows the outer perimeter of the reef flats, as taken from historic maps. The islands will be spaced apart from each other enough to let tidal action occur to ensure proper circulation in Ke‘ehi Lagoon. There will be a system of fixed walkways to navigate between islands. The islands will be constructed using recycled materials taken from the nearby industrial site and from the demolition of structures for the rail. Recycled materials will be tested to ensure non-toxicity. The creation of these islands facilitates a very natural engagement with water and the natural environment. They also double as a platform for the formation of an oyster reef.

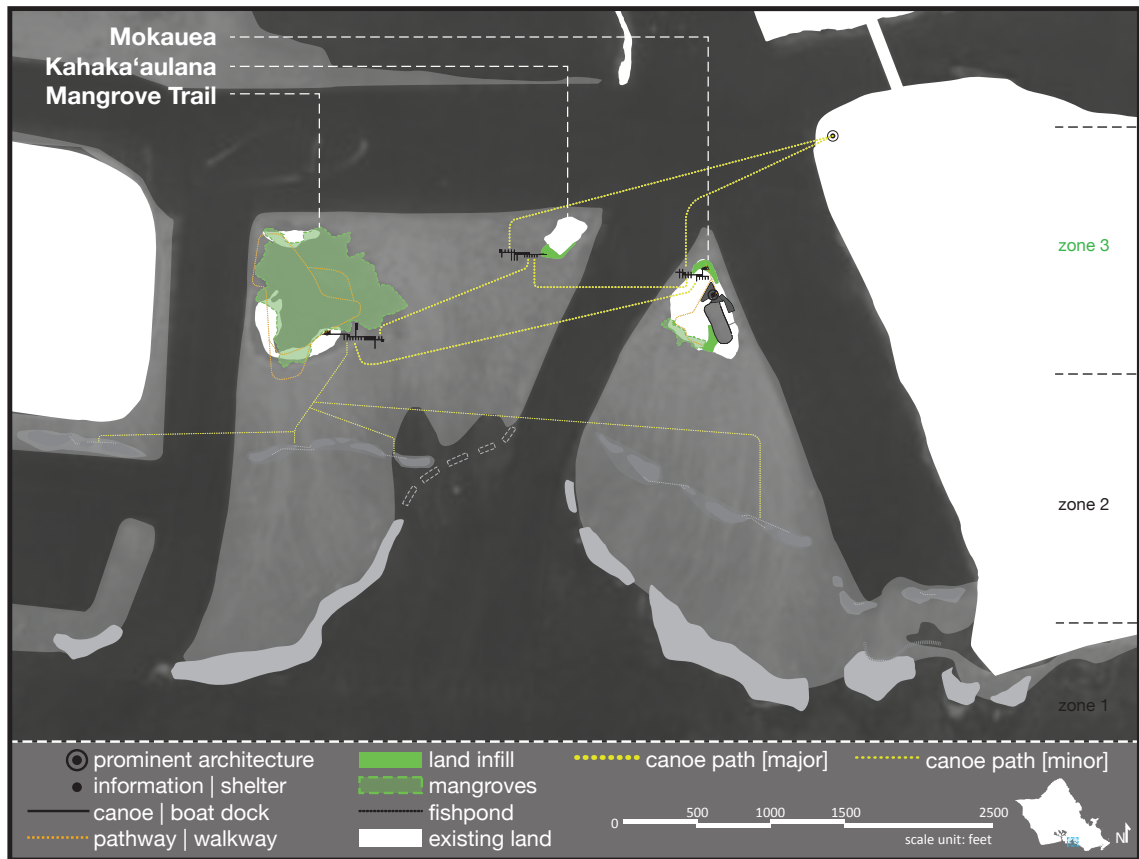




**Figure 64: Section Cut Through Living Barrier Island**  
[Data referenced by Oyster-Tecture and Rising Tides, graphic by author]



### Zone 3 : Park Experience



**Figure 65: Zone 3, The Experience**

[Image from Google Maps, graphic by author]

Zone 3 is the highlight of the Water Network Experience, providing a significant portion of the user interface, interacting with most aspects of the system. As mentioned earlier, Zone 3 is further broken down into 3 sub stations: Mokauea, Kahaka'aulana, and the Mangrove Trail. Each part of Zone 3 offers historical, cultural, or ecological insight, while engaging the user within the natural environment. Users are encouraged to wander through the site at their own pace, and at their own sense of adventure or ability. Most importantly, Zone 3 offers a platform to experience and embrace the true essence, intangible significance and vitality of Mokauea through a sensitively designed physical setting. The inspiration for the design research project is the fight for the continuance of Mokauea, and therefore, Mokauea will be the focus of the Network, forming the Hub of the open water section of the Experience.

### *Mokauea Information Complex*

Existing Mokauea will be used as the hub for the natural waterpark experience. As discussed in chapter 2, application for cultural and historical preservation warrants the validity of Mokauea as a place of cultural significance. Mokauea is the physical remnant and representation of ancient fishing villages.

#### **Information Center**

An information center will be located here to guide users through the site and offer educational opportunities to learn about the historical and current significance of Mokauea, and aspects of Native Hawaiian culture including dying maritime skills. Research in all previous research will be condensed physically here, providing awareness.

#### **Viewing tower**

A viewing tower will offer a panoramic view of the entire Ke'ehi community. The height advantage will be used to witness the natural beauty of the area, to gain a different perspective of the site, and to understand the holistic system of the Water Network Experience.

#### **Canoe Paddling Platform**

In addition to an information center, a canoe-viewing platform is incorporated into the design to witness the spirit of ocean navigation and recreation. The channel between Sand Island and Mokauea is a popular area for canoe paddling, and is known by locals as one of the only places you can coach from the beach for the entire length. Traditionally in Native Hawaiian culture, canoes were the primary source of transportation, and the sole reason migration to Hawaii was possible. Through cultural evolution, canoe paddling became a popular sport and continues to be today.

There will also be a large deck that overlooks the fishpond that can be used as a gathering space, performance space, and event space.

#### **Fishponds**

The accepted scientific definition of aquaculture is the cultivation of aquatic animals and plants as a source of sustenance. Cultures around the world and throughout history has relied and practiced some form of aquaculture. Egyptians, Mesopotamians, and

Assyrians built artificial fishponds; Greeks and Romans cultivated oysters; South East Asia practiced many different forms of fishing techniques.<sup>149</sup> In Pre-contact Hawaii, Native Hawaiians used every part of the watershed for food production, from the deep ocean to upland forests, congruent with the principles of an ahupua'a system. Native Hawaiians depended on fishponds as the main source of protein, and as such, perfected fishpond-building skills. The ingenuity and uniqueness of the makaha or sluice grate, allowed for a consistently dependable source of protein.

According to Apple and Kikuchi in, *Ancient Hawaii Shore Zone Fishponds: An Evaluation of Survivors for Historical Preservation*, there are five different types of loko or pond. The fishponds prevalent in the Ke'ehi Lagoon area were called loko kuapa, and distinguished by the use of a seawall and contains at least 1 sluice grate.<sup>150</sup>

Prior to Western contact in 1778, there were an estimated 480 fishponds statewide. Acting as such an important component of the Native Hawaiian culture, it was believed that fishponds contained spiritual power, harnessing the presence of akua, gods, and 'amakua, ancestral gods.<sup>151</sup> This belief reinforces the spiritual and physical connection between man, gods, and nature.

The disappearance of fishponds can be directly linked to the arrival of Western foreigners. The sandalwood trade forced fishpond workers to work in the forests, therefore causing the fishponds to degrade due to lack of maintenance. Also, the solicitation of Western foreigners taking excessive amounts of fish from the ponds cause an imbalance in supply, similar to current overfishing trends. According to Apple and Kikuchi, there are only 6 excellent condition, 15 good condition, and 36 fair or poor condition ancient fishponds that remain today, as the consequence of coastline development, and an overall change to culture and daily lifestyles.<sup>152</sup>

The purpose in maintaining the current fishpond on Mokauea Island is to remember and give respect to the past, while educating for the future. It can also be used as a platform

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<sup>149</sup> Russell Apple and William Kikuchi, *Ancient Hawaii Shore Zone Fishponds: An Evaluation of Survivors for Historical Preservation*, (Hawaii: State of Hawaii Department of Land and Resources, 1975).

<sup>150</sup> *Ibid.*

<sup>151</sup> "Loko I'a-Fishponds," Malama Aina, accessed January 10, 2015, malamaaina.org. unit 4 biological community awareness.

<sup>152</sup> Apple and Kikuchi, *Ancient Hawaii Shore Zone Fishponds*.

to transfer the knowledge of Native Hawaiian fishing techniques, and function as an economic driver.

#### *Caretaker's Residence*

As mentioned earlier, there are four families currently residing on Mokauea Island. Multiple site visits reveal that structurally, three of the homes will not survive even a small change in sea level rise. At current MHHW levels, water is infiltrating two of these structures, and is dangerously close to another. Only the house located on the northern tip of Mokauea is able to accommodate for sea level rise, currently resting 5+ feet above water level. The owner of this specific property is Joni Bagood. On many occasions she has expressed interest in her continued involvement with preserving and proliferating the essence of Mokauea, already considering herself caretaker of Mokauea as discussed in Chapter 2. It would be fitting to employ her and her husband as resident caretakers of the Island.

#### *Kahaka'aulana*

Kahaka'aulana is a tidal island directly west of Mokauea Island. According to archaeologist, historian, and co-founder of Malama Mokauea, Kehaulani Kupaheha, Kahaka'aulana was home to spiritual Kahunas or priests, known for their astrological and navigational knowledge, and deep understanding of weather and climate.<sup>153</sup> According to Mana, ipuho'okelewa'a, navigational gourds, were stored on the island.<sup>154</sup> An information shelter will be used to allow the user to understand the breadth of Native Hawaiian navigational skills and intimacy with their environment.

#### *Mangrove Trail*

Mangroves are known as a positive addition to a coastal environment by: their ability to tolerate saltwater, provides erosion control, mitigates storm surges, and provides a habitat for marine creatures. In Hawaii, the red mangrove, Rhizophora mangle is a non-native invasive species.<sup>155</sup> The negative attributes of the mangrove include: a smothering root system out-competing native Hawaiian plants, fills coastal regions with accumulated anoxic sediment. While there are both negative and positive attitudes towards the use of mangrove, growth needs to be controlled within the Ke'ehi Lagoon area.

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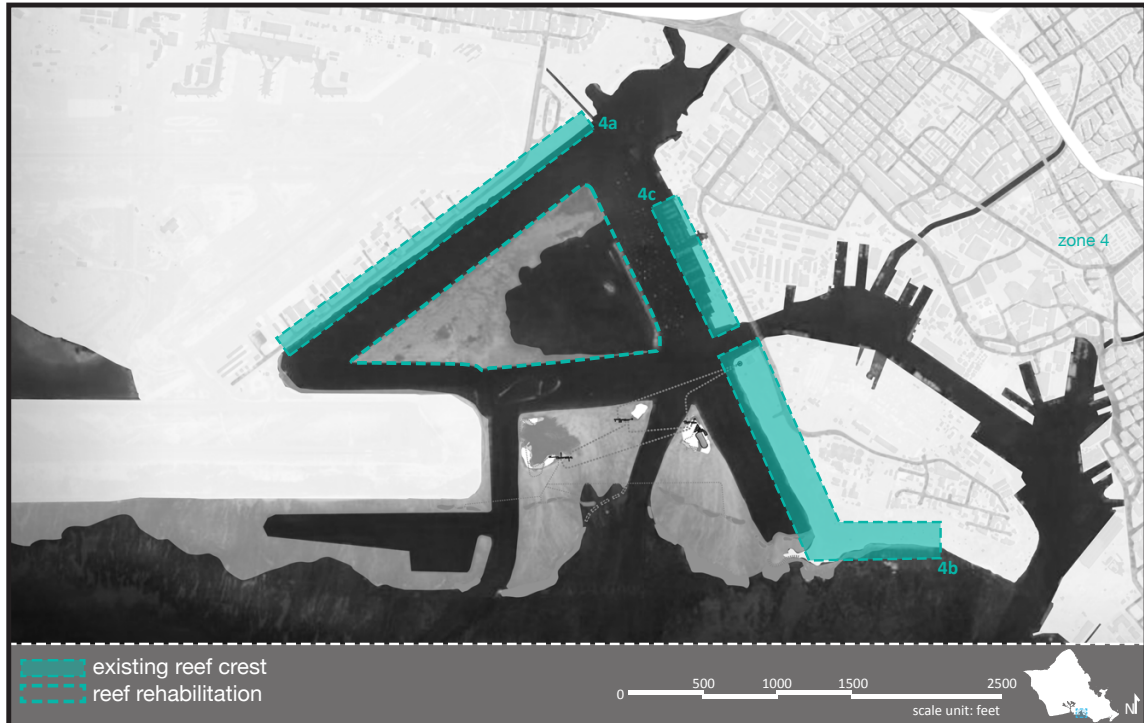
<sup>153</sup> Quitoriano, Jandi. "Visit to Mokauea Island." Field trip excursion. Conducted by Ho'ola Mokauea, Honolulu, multiple dates, 2014-2015.

<sup>154</sup> "Mokauea Lives and Breathes," MANA, accessed April 18, 2014, <http://www.welivemana.com/articles/mokauea-lives-and-breathes>.

<sup>155</sup> "Mangrove in Hawaii," All About Mangrove, accessed February 20, 2015, <https://mangrove.wordpress.com>.

The growth or spread of Mangroves will be contained using a series of netting to catch and remove mangrove seeds. The walkway system will be used to aid in the formation of the netting units. The existing mangrove forest will be used to educate users about invasive species and control methods, as well as the positive attributes of mangrove planting. A journey of walkways interweaving within the mangrove will embrace and engage the user, creating a hands on experience.

#### Zone 4: Perimeter



**Figure 66: Zone 4, The Perimeter**

[Image from Google Maps, graphic by author]

The Perimeter of Ke'e Lagoon is prone to the negative impacts of climate change. As mentioned in Chapter 2, coastlines are vulnerable to erosion and water inundation. Taking cues from the included case studies, sea level rise can be used as an opportunity to reconnect people with the natural landscape. While all solutions are man-made or altered, the ending result ranges from hard to soft in regards to integration and interaction with the existing landscape.

The design of Zone 4 includes the implementation of natural buffers for sea level rise and storm mitigation along with experimental design for sea level rise near the airport. A constructed salt marsh will attenuate storm surges and use sea level rise and water inundation while creating a platform for user interface, education and appreciation. An experimental

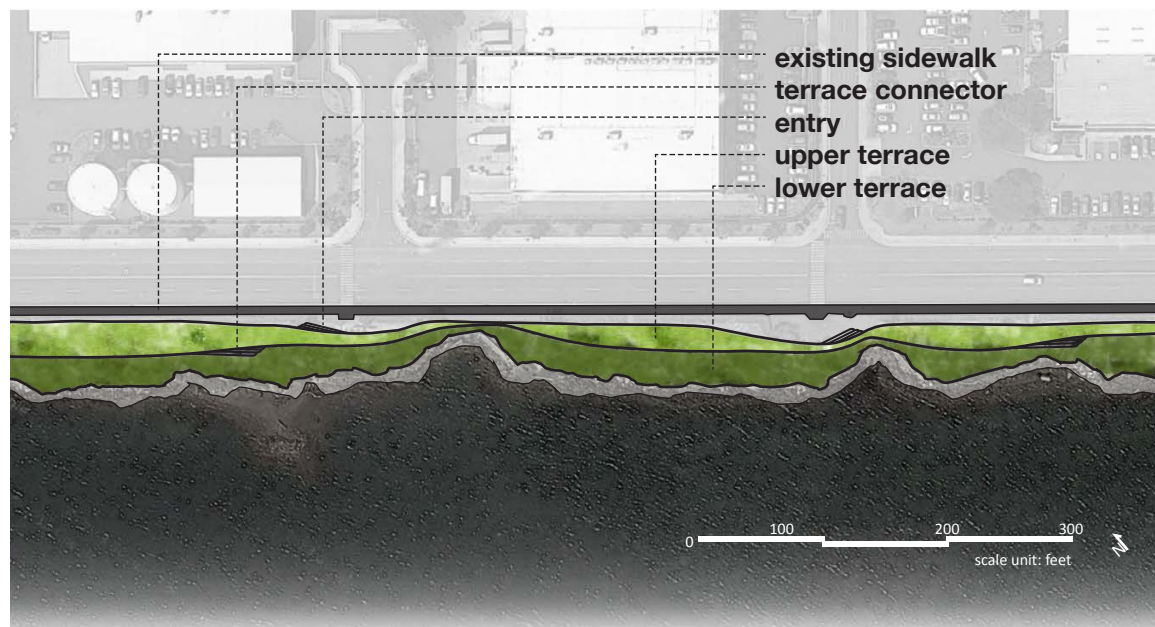
terraced living wall will be used along the Airport side of the Lagoon to test the applicability of a usable berm perimeter to protect the Honolulu International Airport. Finally, a floating pier and dock system will be implemented at the Ke‘ehi Boat Harbor to accommodate for fluxes in sea level.

The outlined triangle area within the Lagoon is intentionally left out of the design due to existing plans for that area and left for future development to be determined on the success of the Water Network Experience.

#### *Visitor's Center*

Located on the Northwestern tip of Sand Island will be the visitor's center and the starting place for the Water Network Experience. The visitor's center will be used to greet guests, provide general site and program information, schedule guided tours, and house the canoe rental center. It will also serve as a gift shop and be equipped with comfort and rest stations. The parking lot will be expanded to accommodate visitors.

#### *4a : Experimental Terracing*



**Figure 67: Zone 4a, Terraced Living Wall**  
[Graphic by author]

Terracing on the Airport side of Ke‘ehi Lagoon will be constructed to test its viability as sea level rise protection. This will be an alternative to commonly used hard-engineered sea wall. The terraced areas will offer areas for recreational uses including: fishing, picnicking, resting,

and airplane watching. The system will have to be replicated around the perimeter of the airport to be completely functional.

#### *4b : Constructed Salt Marsh*



**Figure 68: Zone 4b, Constructed Salt Marsh**

[Graphic by author]

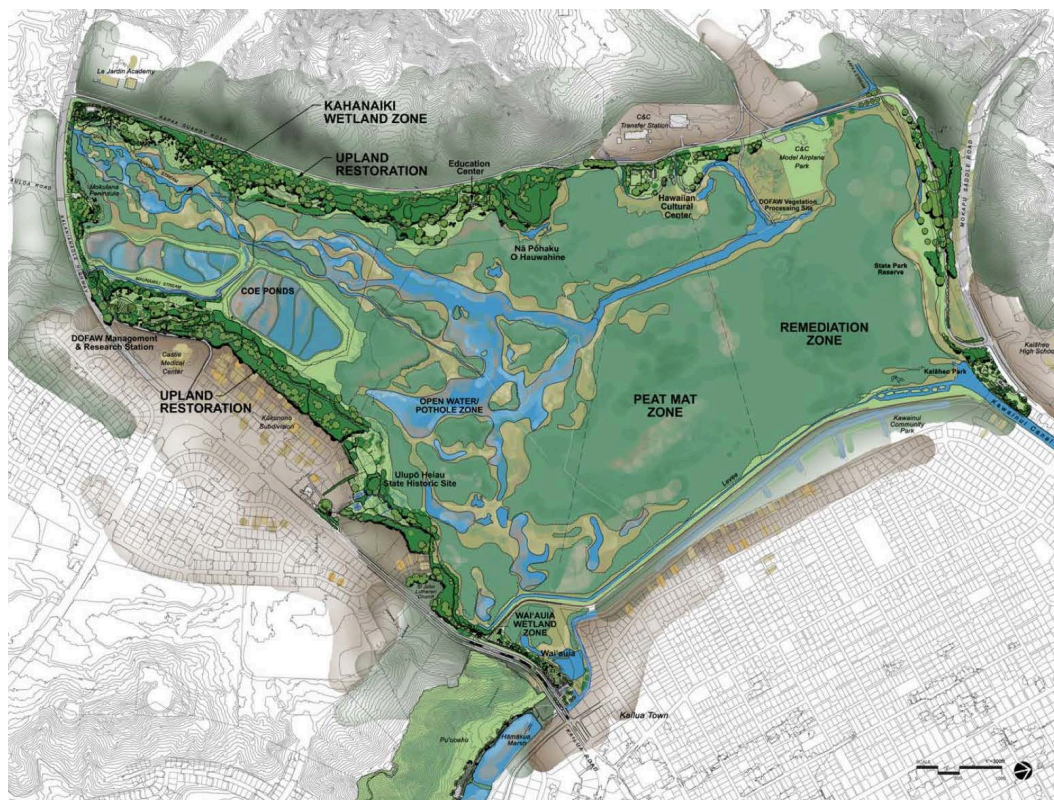
Using sea level rise as a positive, the southern facing coasts of Sand Island will be turned into a constructed salt marsh, respecting environmental change. The new salt marsh will perform as an ecological habitat, base for Native Hawaiian plant restoration, and as storm surge mitigation. Human immersion as shown in the China Wetlands precedent case studies in chapter 5, will allow users to generate an intimate experience with nature, and be involved with adaptation designed for sea level rise. The Kawainui Marsh restoration project will be used to demonstrate the capabilities of an integrated design.

#### **Kawainui Marsh**

Located on the windward side of Oahu near Kailua, Kawainui Marsh is the largest freshwater wetland in the State of Hawai'i, encompassing over 800 acres. Kawainui has evolved from a home for fishponds and a shallow fringing coral reef, to agriculture, and now a wetland. The area is a melting pot of natural and cultural resources.



In 1979, Kawainui became eligible for the listing on the National Register of Historic Places as a “major component of a larger cultural district...”<sup>156</sup> Natural areas undergo conservation efforts for different reasons, and the importance of Kawainui marsh is rooted in cultural history and significance, native bird population and habitat, and is an important member within the Kawainui watershed system. In 2008, Kawainui was designated as a State Wildlife Sanctuary to protect wetlands and wildlife habitat.



**Figure 69: Kawainui Marsh Master Plan**

[Image and graphics by Helber Hastert & Fee, Planners, [www.hhf.com/kawainui/purpose.html](http://www.hhf.com/kawainui/purpose.html)]

The Kawainui-Hamakua Complex Master Plan, under the jurisdiction of DLNR, was developed in response to cultural and environmental preservation efforts. The Kawainui-Hamakua Marsh Complex Master Plan Update includes areas of recreation, education, a canoe house, a hula center, and comfort stations.<sup>157</sup> The master plan for the Marsh accommodates for public use and therefore offers a platform for awareness,

<sup>156</sup> Parks and Helber, Hastert, and Fee Planners, *Kawainui-Hāmākua Master Plan Update Pamphlet* 2011, State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife and Division of State, accessed February 20, 2015, <http://www.hhf.com/kawainui/Images/DRAFT%20Kawainui-Hamakua%20Master%20Plan.pdf>.

<sup>157</sup> Parks and Helber et al., *Kawainui-Hāmākua Master Plan Update*.

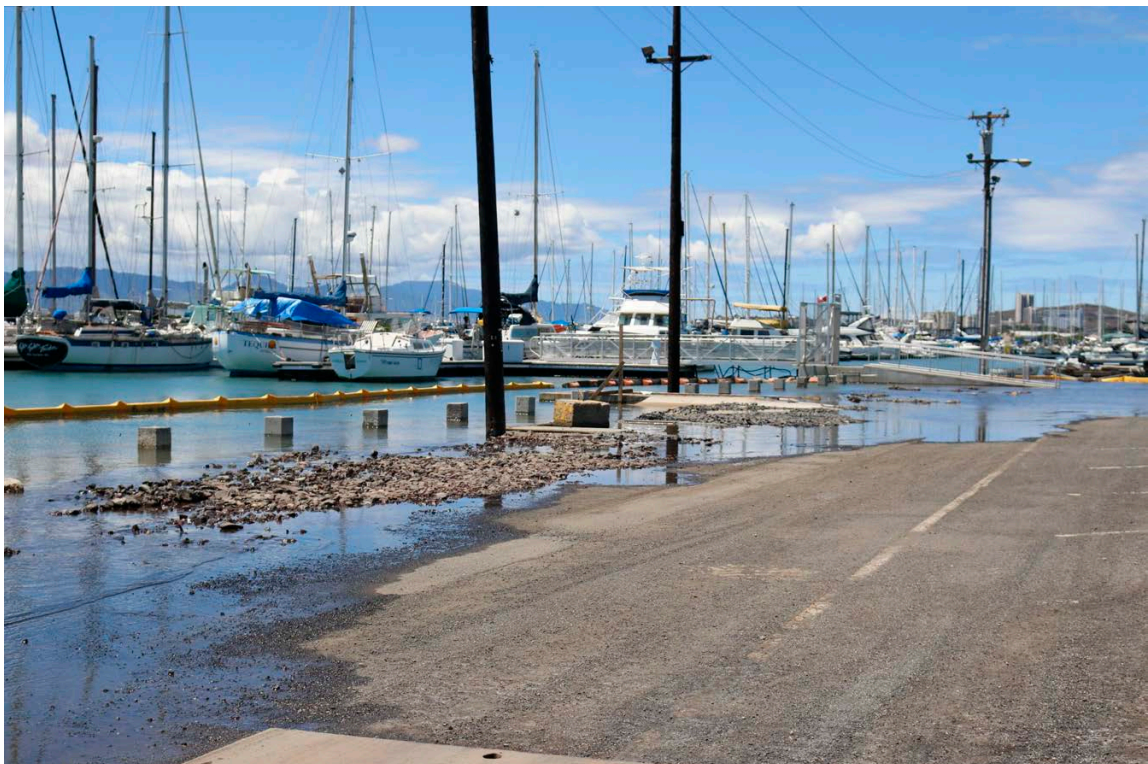
education, connection, and integration, creating a blend between conservation and integration.

What is truly inspiring about the project is the involvement of the community in the design and decision-making processes. Many community meetings were conducted to inform and gather perspectives and suggestions for the design of the master plan, and there are monthly clean up days to restore the Kawainui Ponds, Ulupo Heiau State Historical Park, and Na Pohaku o Hauwahine.

The south south-west coasts of sand island will be designed as a constructed salt marsh in hopes to reinvigorate the site to a more natural setting, allowing for the use of Native Hawaiian plants, and creating or reinforcing a connection to the natural environment.

#### *4c: Floating Dock*

Ke'ehi Boat Harbor is currently witnessing the effects of climate change and sea level rise in conjunction with possible structural degradation. A visit to the area showed infrastructure manholes completely submerged underwater and a parking lot that was being encroached by the coastline.



**Figure 70: Ke'ehi Boat Harbor at High Tide**  
[Image by author]

The Ke‘ehi Boat Harbor is an integral element within the existing function of the Ke‘ehi Lagoon system. As mentioned in chapter 2, all maritime recreational vehicles currently harmoniously coexist within the lagoon, and it is not the intention to impede on existing functions. A floating dock system has the ability to flux with changing sea levels, allowing for continual function.

## **ARCHITECTURAL DETAILS**

### **Walkways**

Different types of pathway structures will be used to allow the user to experience different aspects of the mangrove forest. All walkway structures will maintain a sensitivity to the natural environment. There will be four different types of walkways implemented throughout the site including: floating, stilted, rock, and submerged. Floating walkways offer the greatest capacity to incorporate flux related sea-level rise. Stilted structures will be used when there is a need for a more permanent or stable structure. Rock walls will be constructed out of recycled materials and offer the most stable and natural walkway system. Submerged walkways will be used primarily to offer a smooth surface on the reef flat to traverse through water. The four walkway types are illustrated in Figure 72.

### **Docks**

The floating dock system is modeled after Solent Marine’s Simbro floating dock design.<sup>158</sup> A metal support structure with wood planking is supported by floating modules, and guided by fixed poles. The guide poles anchor the platform in place laterally while allowing variable movement in height. Floating Docks will be available for port at Mokauea, Kahaka‘aulana, the Mangrove trail, and a future designated area near the barrier islands. The dock system will also provide open platform spaces available for gathering, resting, picnicking, etc.

### **Entry | Information Shelters**

Entry shelters will be implemented near canoe | boat docks to offer a feeling of arrival, and will provide shade, rest, and gathering spaces. Information shelters will house educational material pertinent and appropriate to the site. They will also serve as protection from the elements and inhabit locations on or near walkways/pathways. Both the entry and information shelters will use a structure similar to the floating canoe and boat docks as illustrated in Figure

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<sup>158</sup> “Simbro,” Solent Marine Ltd, accessed February 20, 2015, [http://www.solentmarine.com/simbro\\_system.html](http://www.solentmarine.com/simbro_system.html).

71. The only addition will be an adjustable height-locking mechanism to ensure stability while accommodating for fluctuations in sea level rise. As illustrated in figure 73, the shelters will be primarily constructed with wood members and slats, with the addition of metal bracing where necessary. In the case of extreme weather conditions including tropical storms, hurricanes, tsunamis, etc., units are designed to fold down, reducing the impact of wave energy associated storm surges.

## **Information Complex [Mokauea]**

### *Program*

As mentioned earlier, the main information complex on Mokauea will house several functions including: an education and information center, a canoe viewing platform, a pond viewing deck, and a viewing tower. The construction of the complex will use stilt foundations to reduce the negative impact on the existing reef flat, and allow for the continuance of water circulation. There will also be a walkway system connecting the main information complex to man-made islands situated along the outer edges of the current Mokauea shoreline at MHHW reflecting and honoring the physical historic significance of Mokauea.

### *Phasing*

Construction will occur in phases beginning with the information complex. Walkways and man-made islands will be constructed as necessary to accommodate for sea-level rise. This is to ensure the usability of the island for current residents, as their lease is not up until 2043.

### *Materials | Construction*

As discussed in chapter 1, traditional Native Hawaiian structures were made from ohia, kalia, ahakea, and other native woods that may have been common at the time, but are now rare. Limahuli director Dr. Kawika Winter explains that, “A foundational ethos in Hawaiian resource management is that you don’t use natural resources unless they are abundant enough to sustainably harvest, in other words, you don’t use the rare stuff. We don’t blindly follow practices that were documented in the 19<sup>th</sup> century ethnographies. We use the wisdom of our ancestors to guide the implementation of traditional practices in the 21<sup>st</sup> century.”<sup>159</sup>

For the entire Water Network Experience, the use of approved materials as determined in the Native Hawaiian Building code, will be chosen when possible, and recycled materials will

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<sup>159</sup> Jon Letman, “Keeping House,” *The Bulletin of the National Tropical Botanical Garden*, volume xxx-1-2, Spring-Summer 2013, accessed January 2, 2015, [http://ntbg.org/cms\\_files/KeepingHouse\\_copyright-NTBG.pdf](http://ntbg.org/cms_files/KeepingHouse_copyright-NTBG.pdf).

be preferred. Although the design is not a literal translation of historic or traditional Native Hawaiian architecture, there are elements included that give reference to the past.

The lava rock wall of the information center hints towards the historic use of the material for foundation purposes. However, only a thin facing will be used to reduce the usage of resourced materials, as the lava rock will need to be harvested.

The use of wooden slats is inspired by Native Hawaiian framing materials and used to suggest distinctions of spaces, while allowing for airflow and visual connectivity. The blurring of indoor/outdoor space is a distinctive characteristic of traditional Native Hawaiian housing units and complexes, and translates into a conceptual design influence for the Information Complex at Mokauea, as all components are designed to be open-air. Although the Mokauea Complex is a more permanent type of architecture, the wooden slats allow water to flow through the spaces in the event of extreme weather, mitigating damage to architectural structures.

Metal armature will be used as the main structural skeleton, providing durability, stability, and a connection to the immediate industrial surroundings. The viewing tower expresses an exposed metal framing, allowing for visual and physical transparency through the structure and relating to the industrial context of the area.

The use of a concrete pile foundation is chosen based on a minimal impact to the existing environment as compared to other methods of construction. The use of piles also allow for continuous water flow maintaining existing water circulation patterns. There will also be minimal impact to the existing marine environment, allowing the continued navigation and occupation of the current site. Again, piles will employ the usage of recycled concrete.

As discussed in chapter 2, the entire Keehi Lagoon historically held productive fishponds that characterized the Native Hawaiian way of life and role as environmental engineers. The fishpond will continue to be an installation on Mokauea as a remembrance of the historic culture of Mokauea. The encasing rock walls will be erected to a height sufficient for function, and will be constructed using recycled materials when possible.

### *Sustainable Energy*

The isolated location of Mokauea island requires the employment of alternative energy solutions. Currently, there is grid power source on the island. Residents rely on gas-

powered generators to supply electricity to their residences. The implementation of rooftop photovoltaic energy production units are necessary to supply necessary electrical power to the Information Complex on Mokauea. There is also the possibility to exercise the experimentation of tidal energy production systems near the complex and within Ke'ehi Lagoon. Tidal power harvesting systems should not interfere with the existing marine ecosystem. If deemed necessary, the use of tidal powered piezoelectric lighting can be used around the sight. For initial design, infrastructure will be designed toward basic functional capabilities.

Potable water is currently provided through a pipe running through Kapalama Channel from nearby Sand Island. The existing practices of reusing grey water will be continued, as well as the use of composting toilets. The implementation of water catchment system will be implemented at a further date as informed by necessary supply data. Sustainable measures are applied in coherence with historic Native Hawaiian practices of resource management and maintaining a balance between humans and the environment.

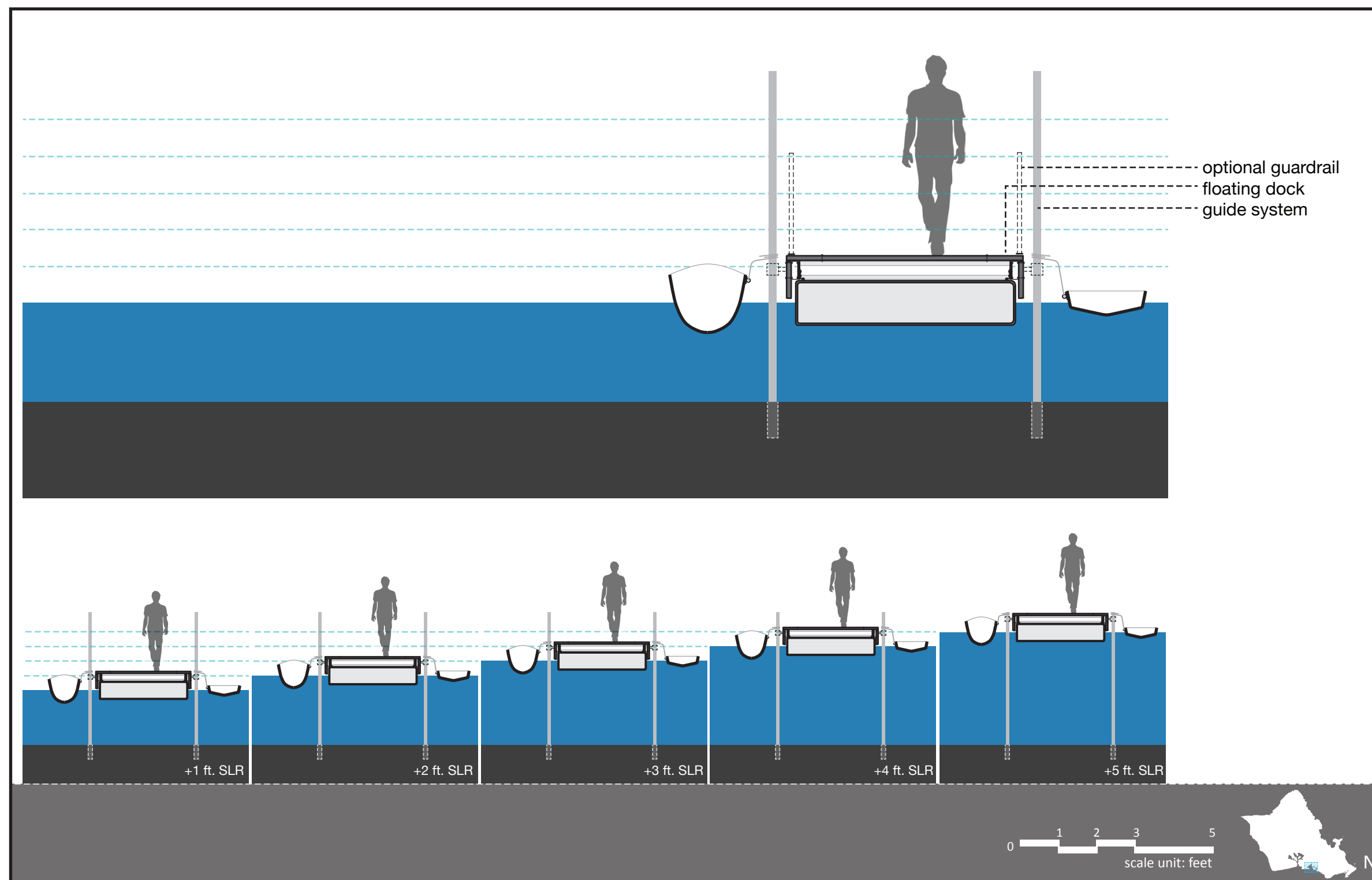
#### *Alternative Use*

Although the primary function of the Complex will be to provide a platform for education and awareness, it will also be used a function space for Native Hawaiian Cultural events including: King Kamehameha I Day, Makahiki, Kuhio Day, May Day | Lei Day, Ka La Ho'ihō'I Ea (Sovereignty Restoration Day), and Hawaii Independence Day. As well as National Holidays including: New Year's Eve and New Year's Day, Christmas, Independence Day, Chinese New Year, and Memorial Day. Serving as an important vessel for the transference of historical and cultural knowledge, the Water Network Experience will become a cultural center that is open and welcoming. As the Fishermen of the area once did with the immigrants, the Mokauea Complex will welcome all with open arms sharing knowledge while creating an aura of inspiration and acceptance.

#### *Illustrations*

The subsequent illustrations will visually explain the various components of the Information Complex on Mokauea.





**Figure 71: Canoe | Boat Dock Detail**  
[Graphic by author]



on piles



[israelsgoodname.wordpress.com](http://israelsgoodname.wordpress.com)

floating



<https://keithnaylor.wordpress.com>

<http://www.ssdarchitecture.com/works/urbanism/island-of-water/>

rock



<http://www.pd4pic.com/bridge/12/>

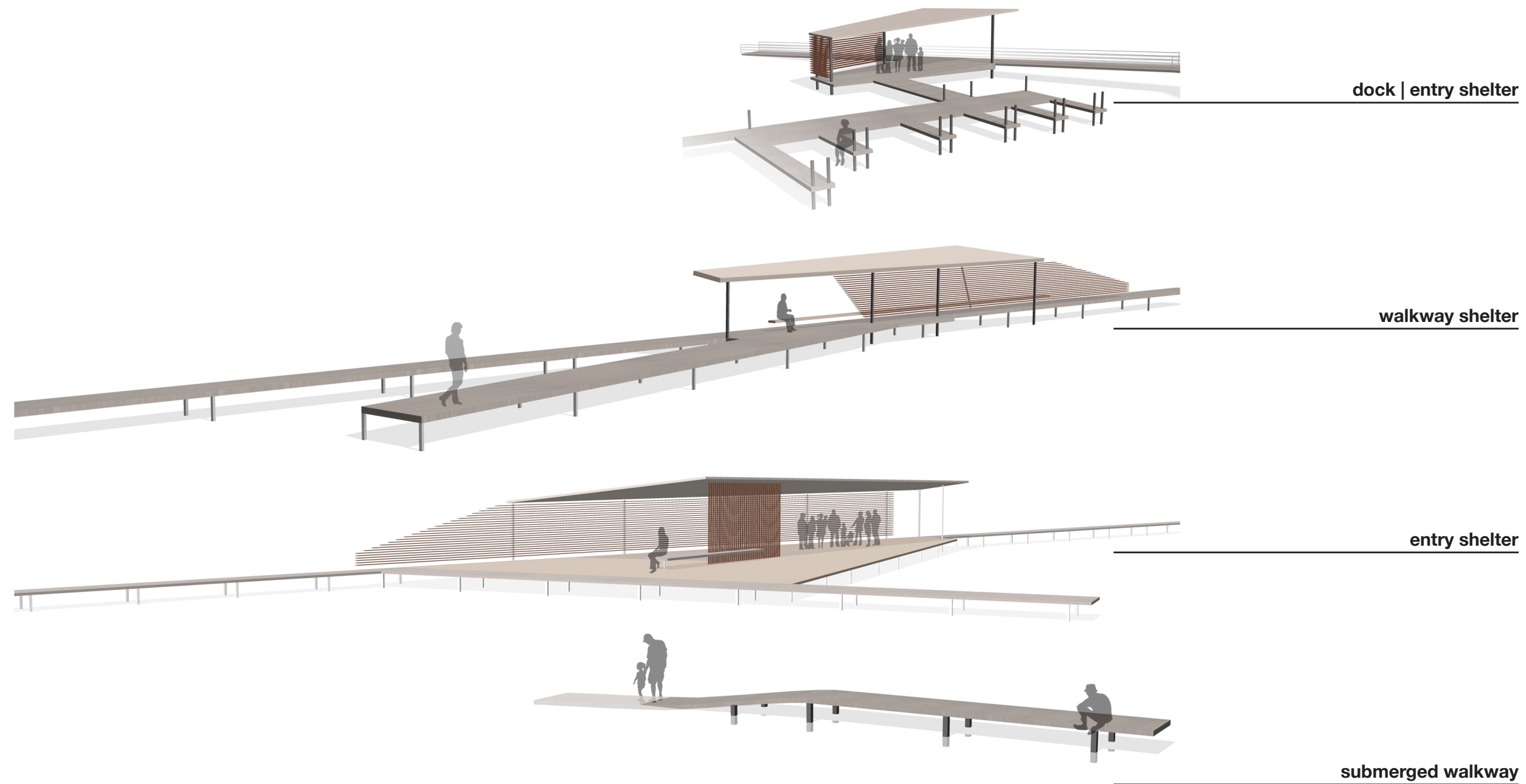
submerged



<http://www.waterplatforms.net/water-walkways/>

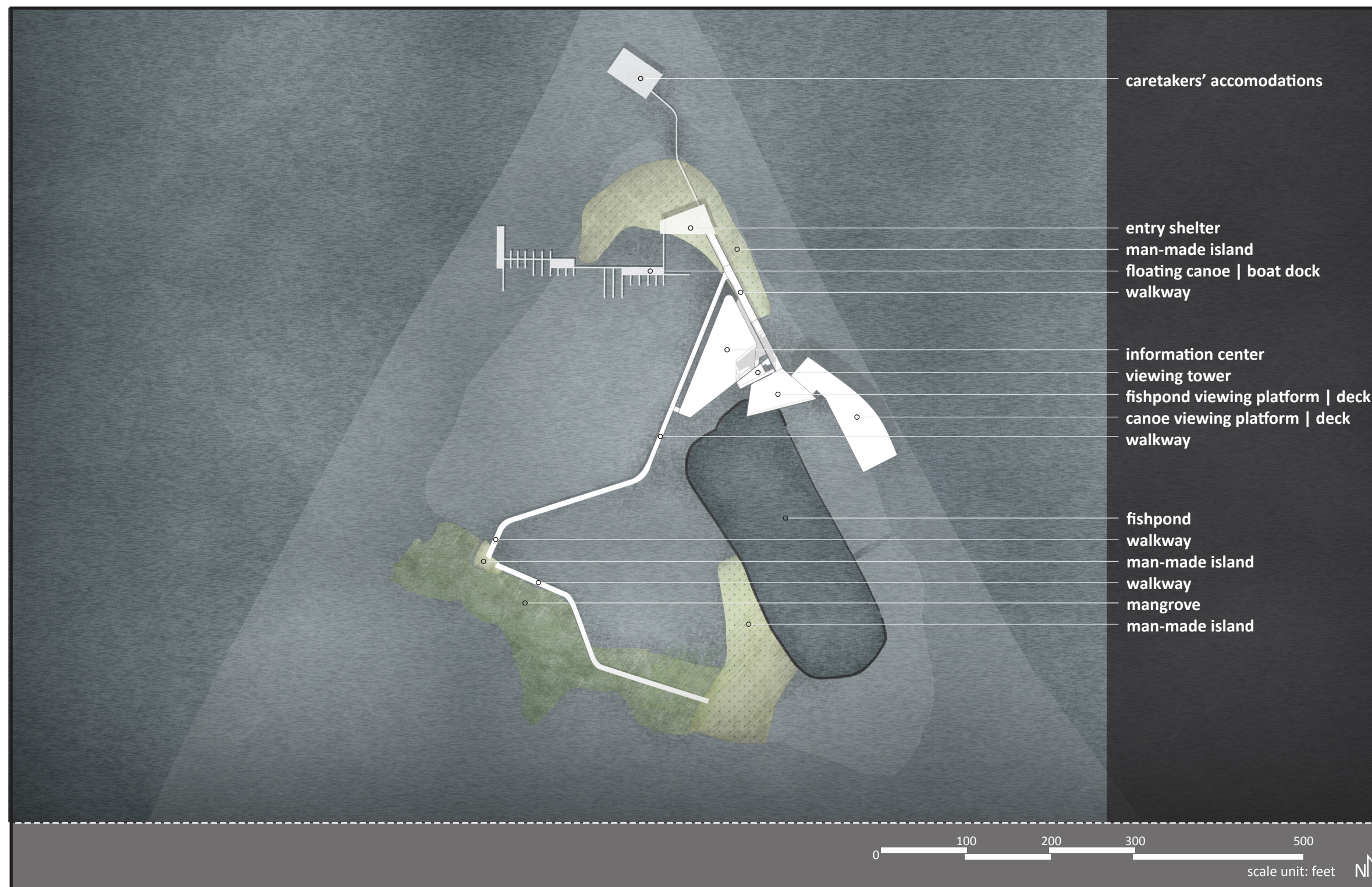
<http://www.waterplatforms.net>

**Figure 72: Walkway Concept**  
[Image sources cited above]



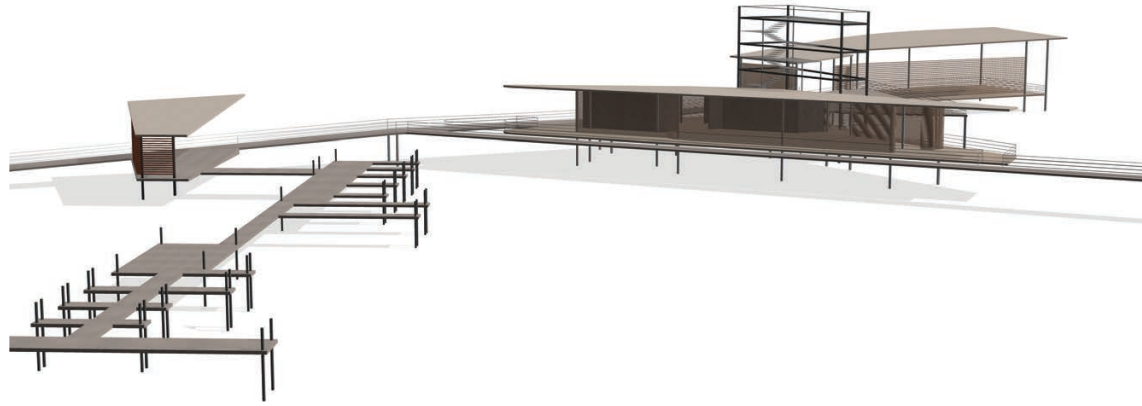
**Figure 73: Entry | Information | Walkway Shelter Examples**  
 [Graphic by author]





**Figure 74: Mokauea Site Plan**  
[Graphic by author]





view: west to east

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view: south to north

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view: east to west

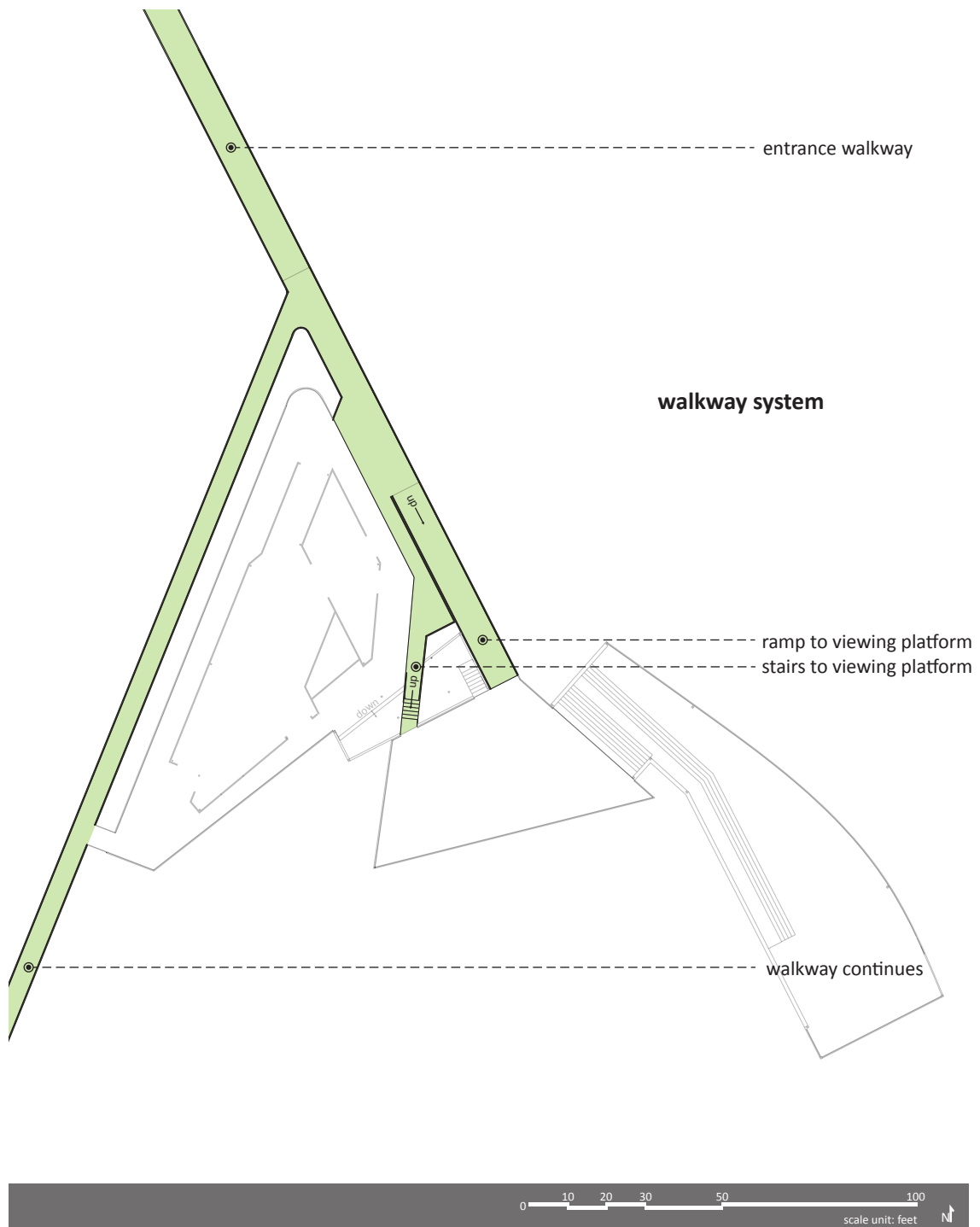
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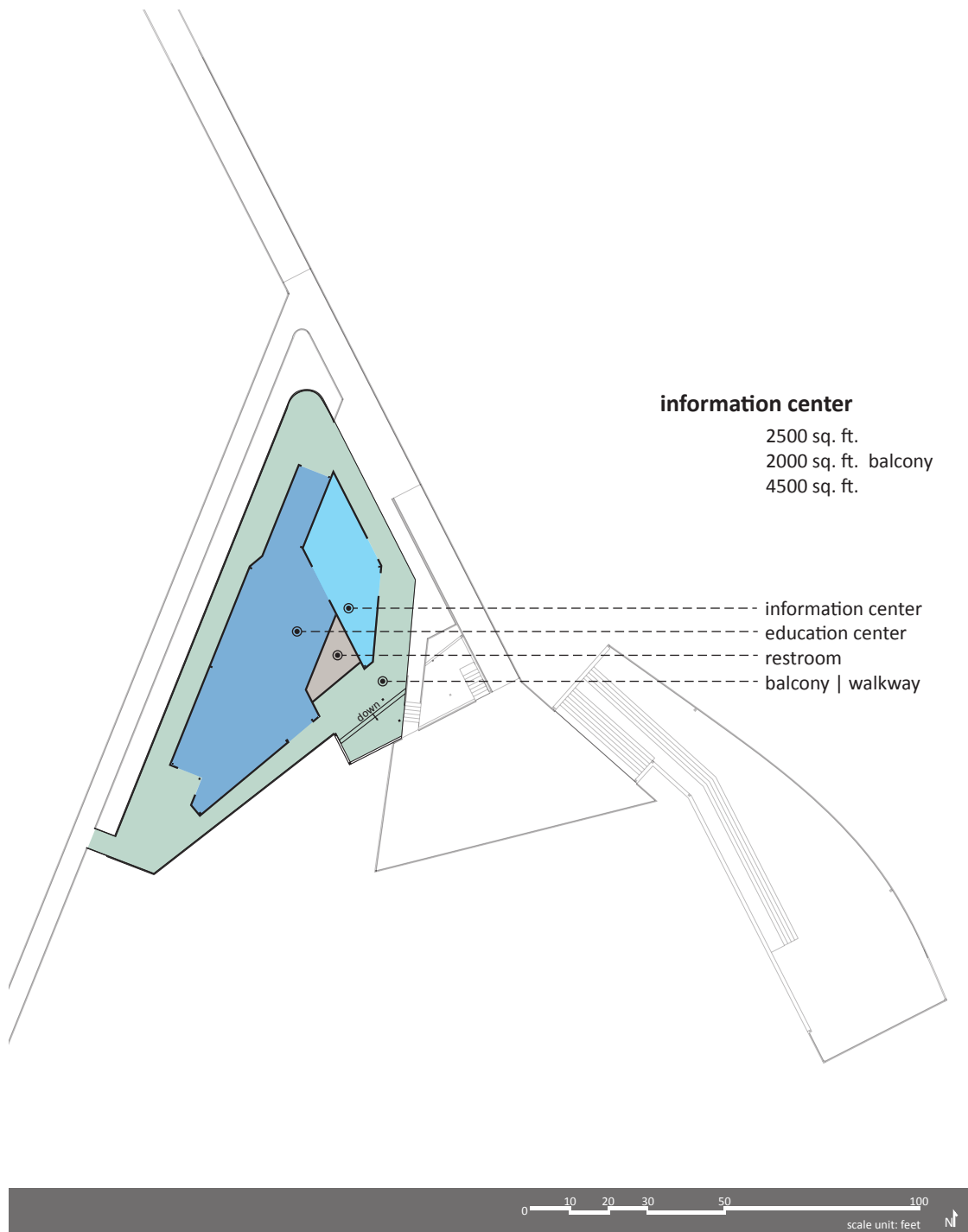
view: north to south

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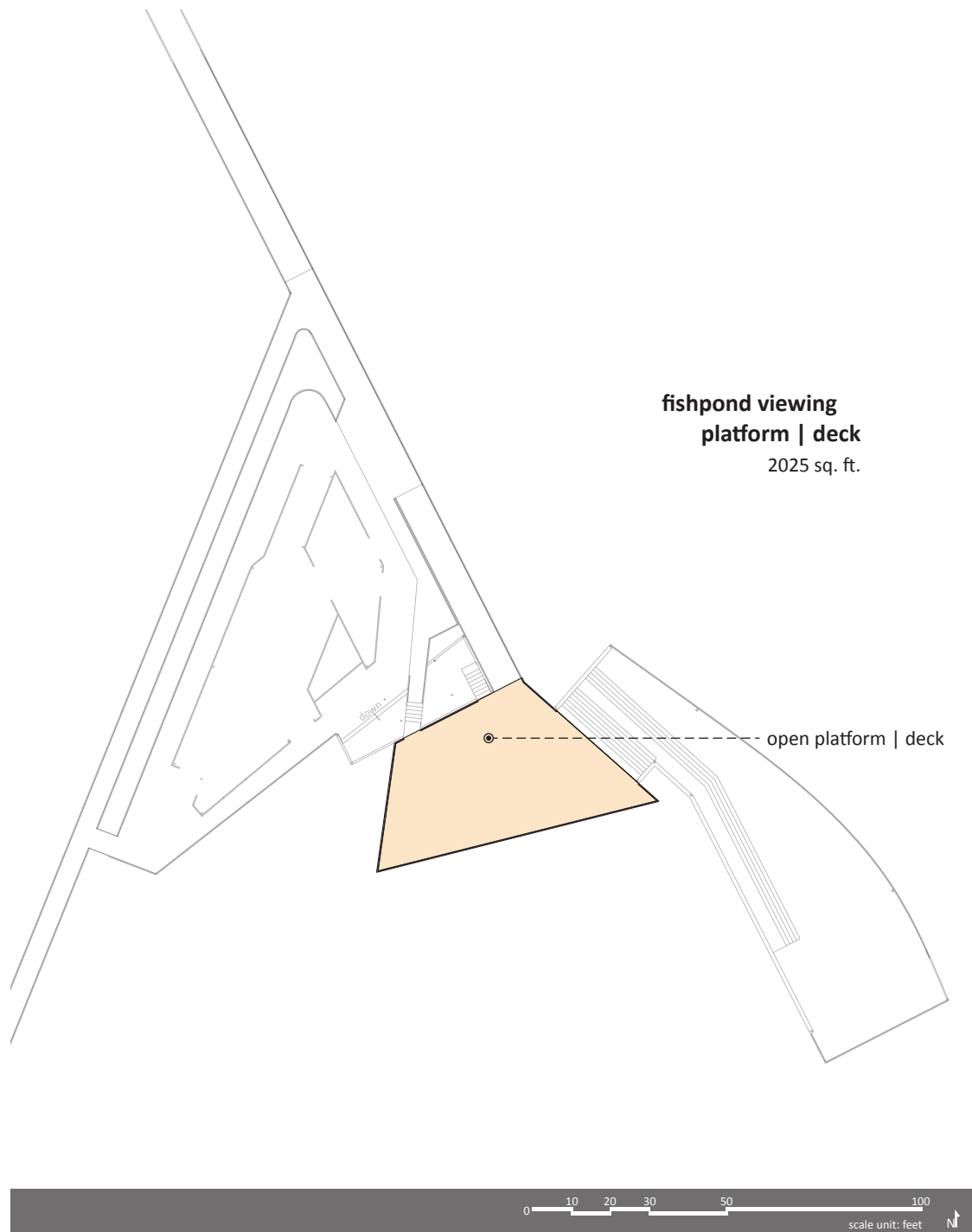
**Figure 75: Mokauea Information Complex**  
[Graphic by author]



**Figure 76: Visitor's Center Program, Walkway**  
[Graphic by author]

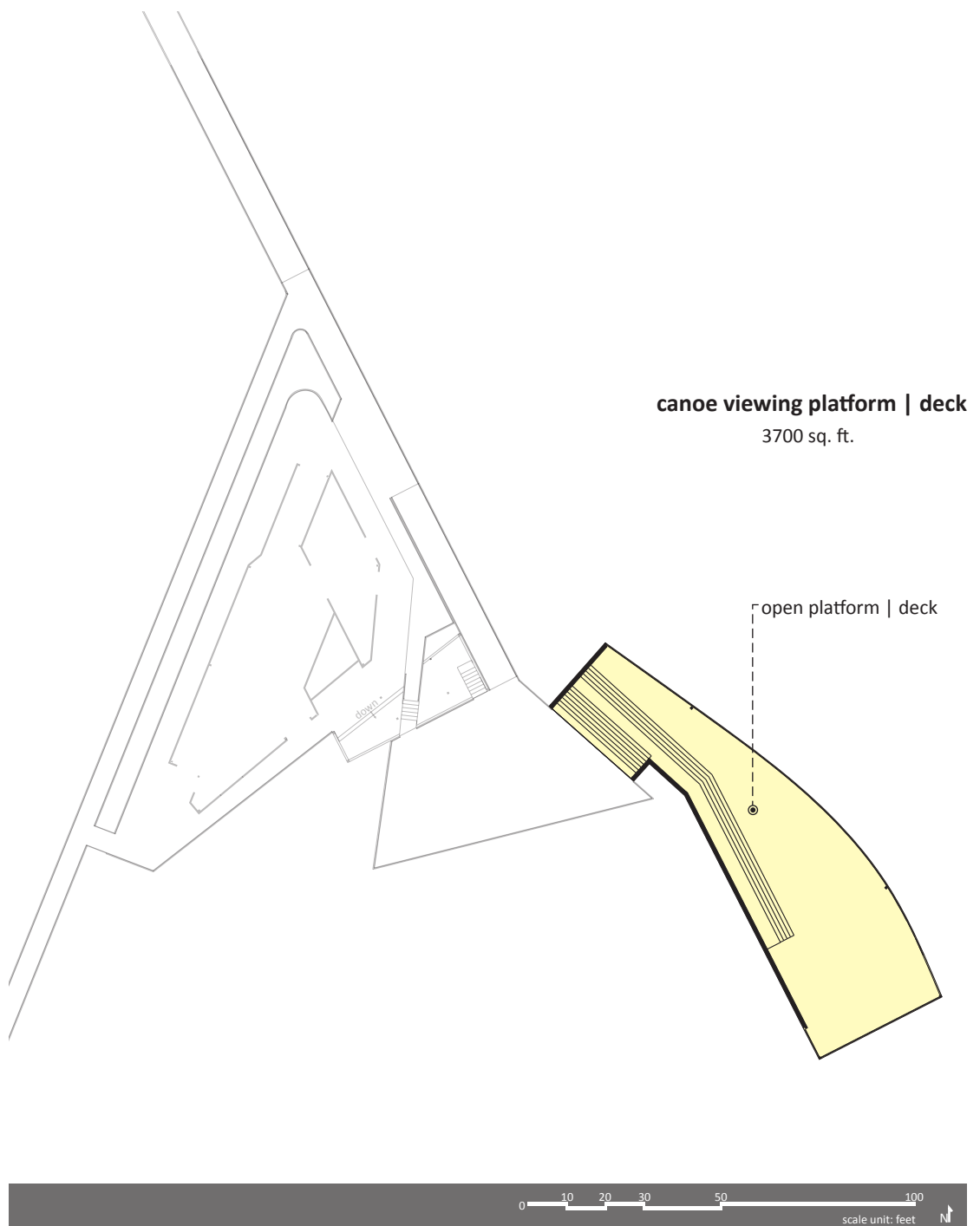


**Figure 77: Visitor's Center Program, Information Center**  
 [Graphic by author]

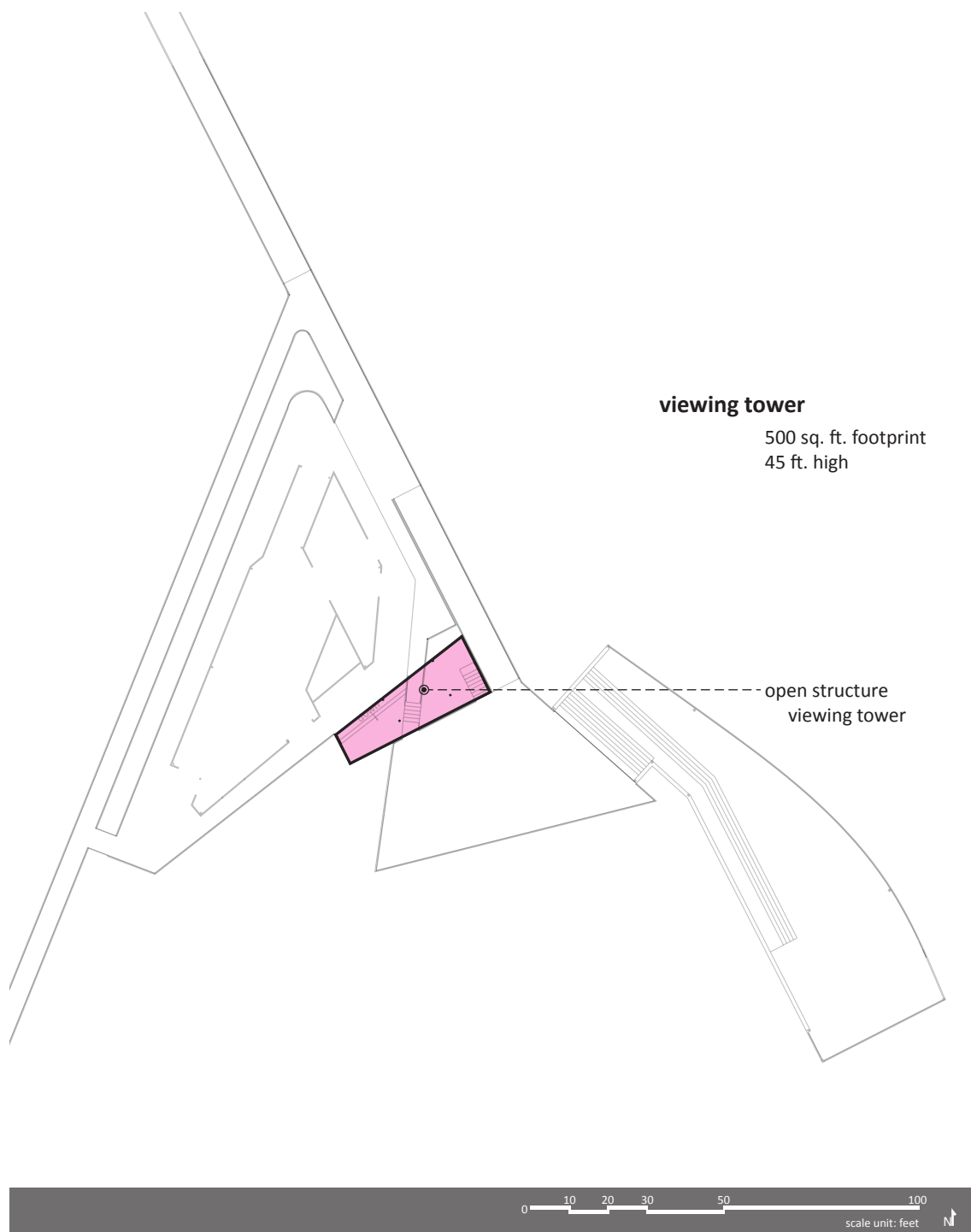


**Figure 78: Visitor's Center Program, Fishpond Viewing Platform | Deck**  
[Graphic by author]

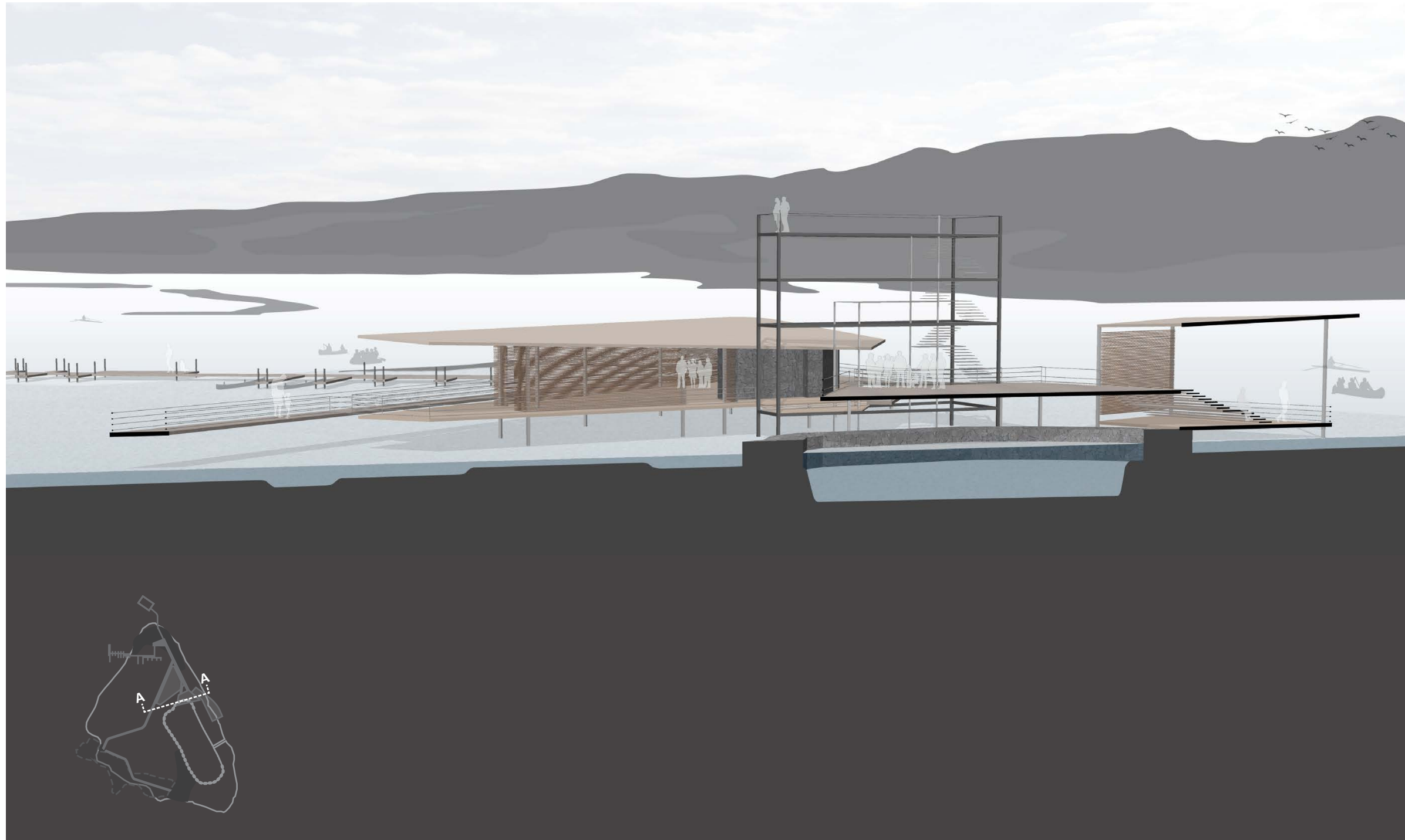




**Figure 79: Visitor's Center Program, Canoe Viewing Platform | Deck**  
[Graphic by author]



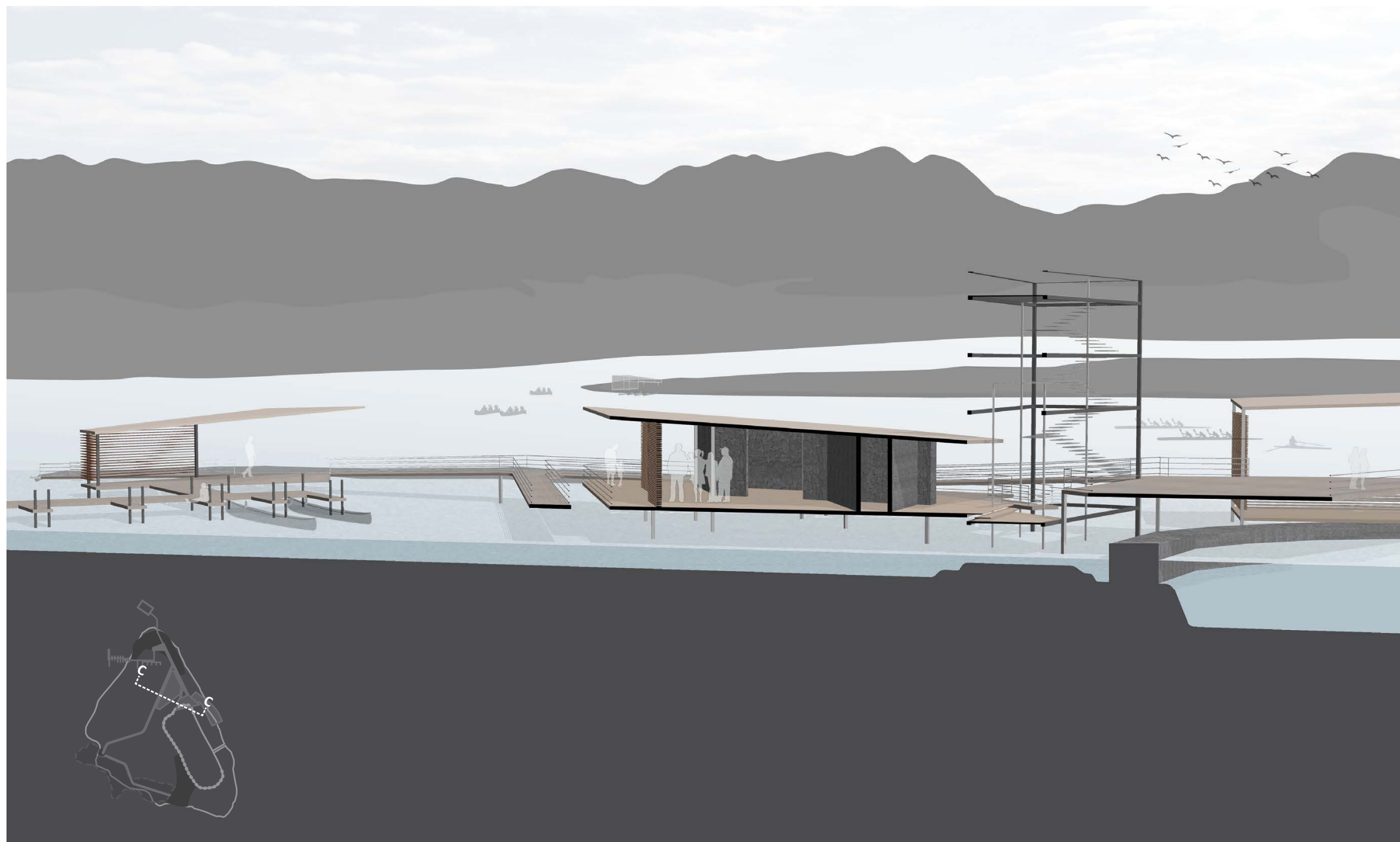
**Figure 80: Visitor's Center Program, Viewing Tower**  
[Graphic by author]



**Figure 81: Information Center Perspective Section A-A**  
 [Graphic by author]

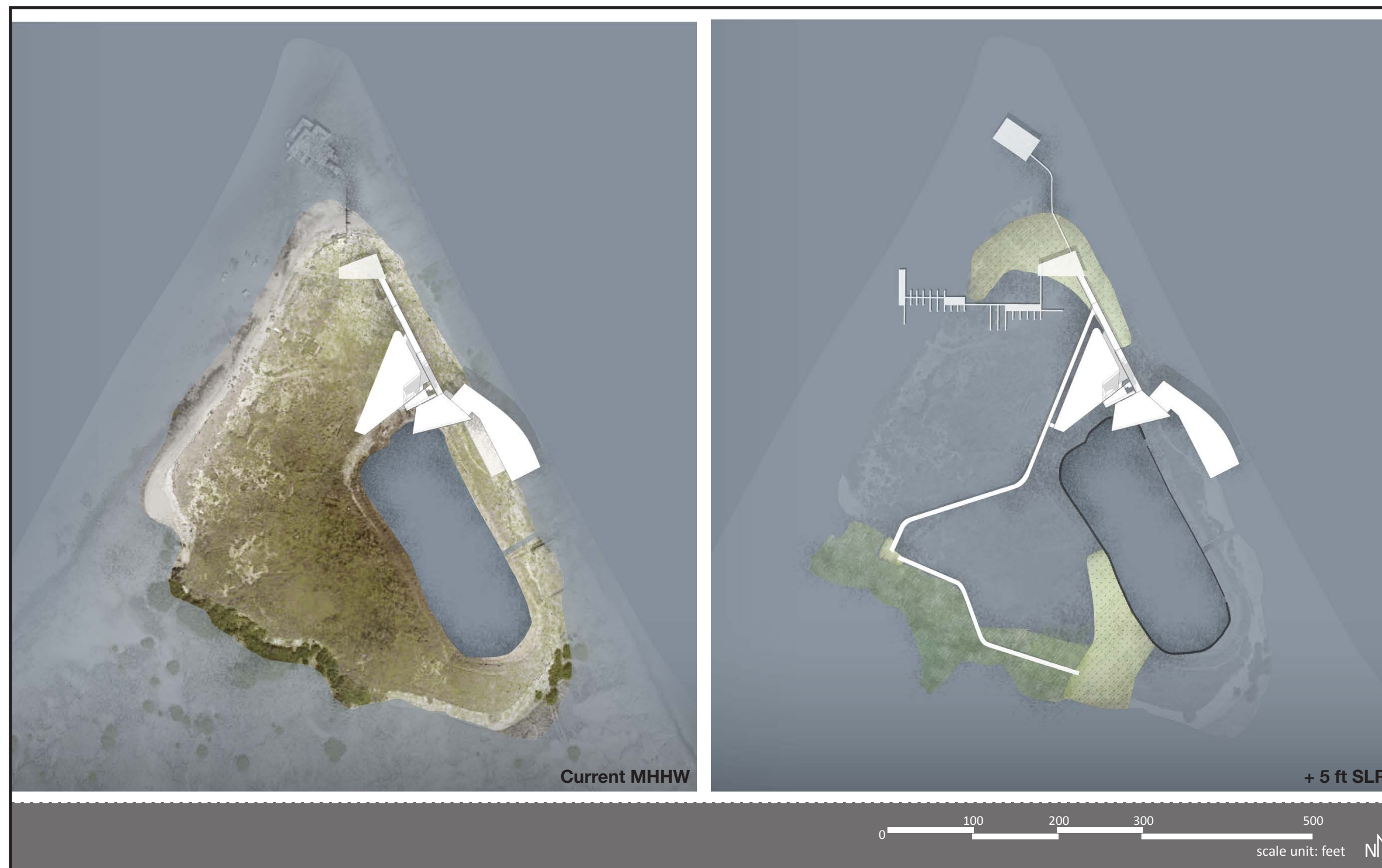


**Figure 82: Information Center Perspective Section B-B**  
 [Graphic by author]



**Figure 83: Information Center Perspective Section C-C**  
 [Graphic by author]





**Figure 84: Mokauea Information Complex Through Sea Level Rise**  
 [Image from Google Maps, graphic by author]



## CHAPTER 7. CONCLUSION

Humanity's relationship with the natural environment has evolved, the balance disrupted. Scientists are providing surmounting evidence of anthropogenic, or human, causes of continuous and unprecedented climate change. Atmospheric and ocean temperatures are rising, ocean level is rising, and extreme weather or meteorological events are occurring. While countries around the world plan for climate change through extensive adaptation strategies, indigenous communities and marginalized populations remain extremely underprivileged financially, politically, and socially inhabiting geographical locations sensitive to the effects of climate change. Indigenous peoples while contributing the least towards climate change, are projected to be exposed to the unproportionately negative impacts of climate change.

Historically, indigenous peoples have displayed a resilience and natural adaptation capacity in relation to climate change through their intimate relationship with their environment. However, the rate and extremity of the projected effects of this era of climate change warrant attention and support, especially with small-island and coastal communities. Continuously surmounting challenges highlight the importance and significance of preservation, protection, survival, and continuance, prompting the need for an adaptation strategy that allows for cultural continuance and self-sufficiency.

Native Hawaiian culture defines the essence of Hawaii and has been historically threatened by social, political, and economical factors. Mokauea is a living example of a physical location that has a culturally rich past shrouded by a turbulent modern history. Anthropogenic climate change is threatening the physical existence of Mokauea, and challenging the continuance and remembrance of the inherent cultural significance rooted in traditional Native Hawaiian maritime activities and knowledge.

By using a framework defined by research into the sense of place of Mokauea Island and Ke'ehi Lagoon area, the proposed design project aims to create a water network experience performing as a holistic design, working together as a system, creating intimacy physically, emotionally, and spiritually, while respecting and honoring the past, and creating a platform for education and awareness for future generations.

The Water Network Experience demonstrates a forward-thinking response, taking the negative connotations associated with climate change, and turning them into opportunities. Modeling after the traditional Hawaiian people as environmental engineers, the design solution provides a 21<sup>st</sup> century adaptation of important aspects of Native Hawaiian culture, the Mokauea and Ke'ehi community and environmental projections. While the immediate resulting goal is to ultimately provide cultural and historical proliferation, and an active response to climate change, it also serves as a framework for replication.

Each component of the system was an intervention within the site based on specific cultural, community or environmental influences. Ideas, processes, and solutions can be replicated, expanded or be used as inspiration for future projects along coastlines of Hawaii and throughout the world.

## **APPENDIX A : GLOSSARY OF TERMS**

### **Adaptation**

a change in a plant or animal that makes it better able to live in a particular place or situation or the process of changing to fit some purpose or situation : the process of adapting.

### **Ahupua'a**

a native Hawaiian word for a socioeconomic, geologic, and climatic subdivision of land running from the mountain to the sea.

### **Anthropocene**

a proposed term for the present geological epoch (from the time of the Industrial Revolution onwards), during which humanity has begun to have a significant impact on the environment.

### **Aquaculture**

the cultivation of aquatic animals and plants, especially fish, shellfish, and seaweed, in natural or controlled marine or freshwater environments; underwater agriculture.

### **Belief**

something believed; an opinion or conviction; confidence in the truth or existence of something not immediately susceptible to rigorous proof; confidence; faith; trust.

### **Climate change**

a long-term change in the earth's climate, especially a change due to an increase in the average atmospheric temperature

### **Culture**

the behaviors and beliefs characteristic of a particular social, ethnic, or age group; the sum total of ways of living built up by a group of human beings and transmitted from one generation to another.

### **Identity**

condition or character as to who a person or what a thing is; the state or fact of being the same one as described; the sense of self.

**Indigenous**

originating in and characteristic of a particular region or country; innate; inherent; natural.

**Mitigation**

the act of mitigating or lessening the force or intensity of something unpleasant, as wrath, pain, grief, or extreme circumstances; the act of making a condition or consequence less severe; the process of becoming milder, gentler, or less severe.

**Native Hawaiian**

indigenous people of the Hawaiian Islands of Polynesian origin.

**Sea level rise**

the direct result of climate change, caused by thermal expansion and the melting of major ice sheets due to warmer temperatures.

**Sense of Place**

the uniqueness of the relationship between culture, community, and the environment.

**Storm Surge**

coastal flood or tsunami like phenomenon of rising water caused by extreme weather and natural occurrences.

**Symbiosis**

any interdependent or mutually beneficial relationship between two persons, groups, etc.

**System**

an assemblage or combination of things or parts forming a complex or unitary whole; a coordinated body of methods or a scheme or plan of procedure; organizational scheme.

**Traditional Ecological Knowledge [TEK]**

aboriginal, indigenous, or other forms of traditional knowledge regarding sustainability of local resources.

**Value**

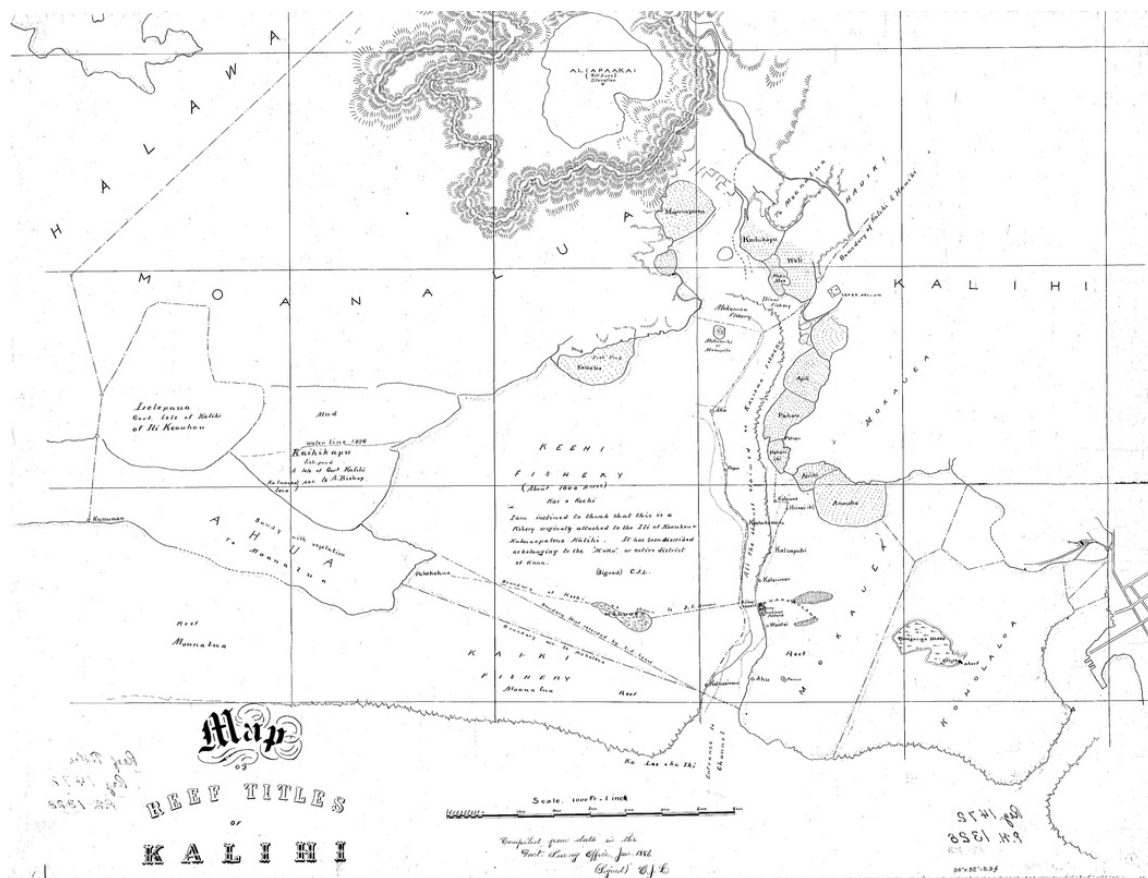
relative worth, merit, or importance.

**Worldview**

the fundamental cognitive orientation of an individual or society encompassing the entirety of the individual or society's knowledge and point of view; a world view can include natural philosophy; fundamental, existential, and normative postulates; or themes, values, emotions, and ethics.



## APPENDIX B: SELECTED HISTORIC MAPS

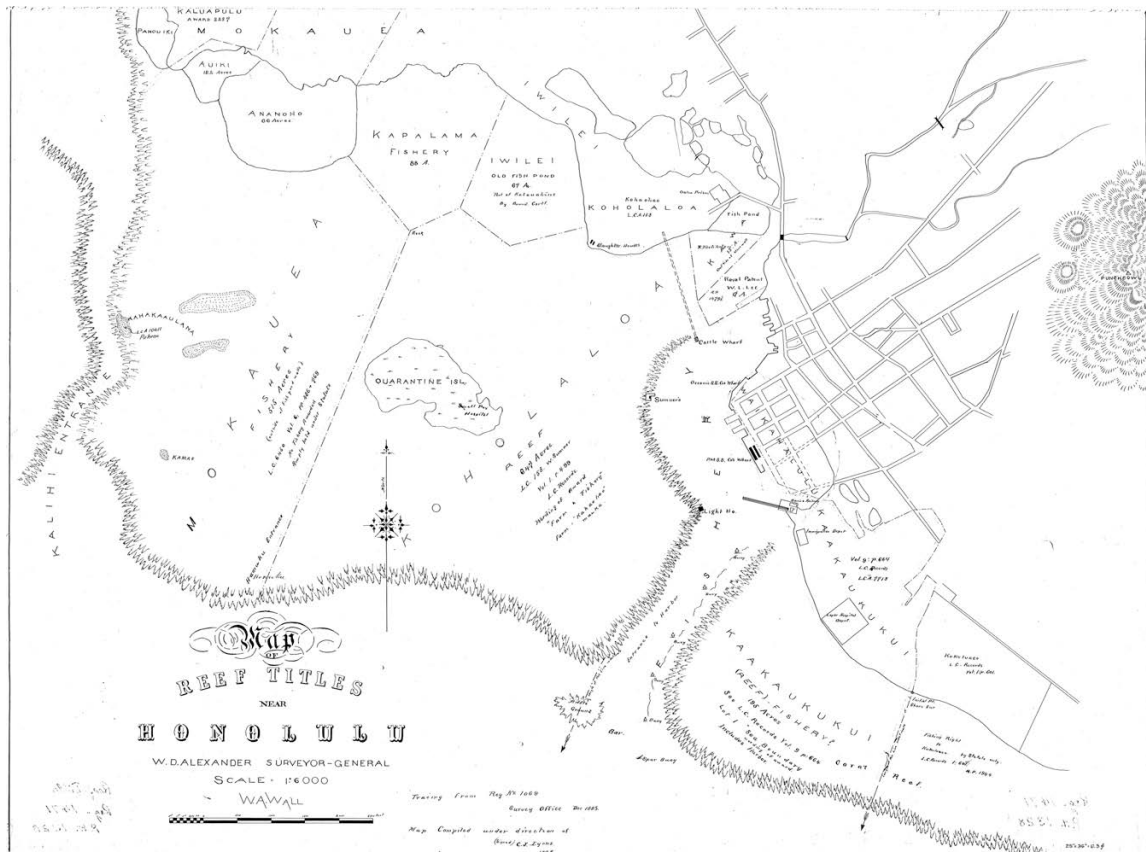


source: Lyons, C. J.

1886 Map of Kalihi Reef Titles.

Registered Map 1472.

Available at the Hawai'i Land Survey Division, Department of Accounting and General Services, 1151 Punchbowl St., Room 210, Honolulu.

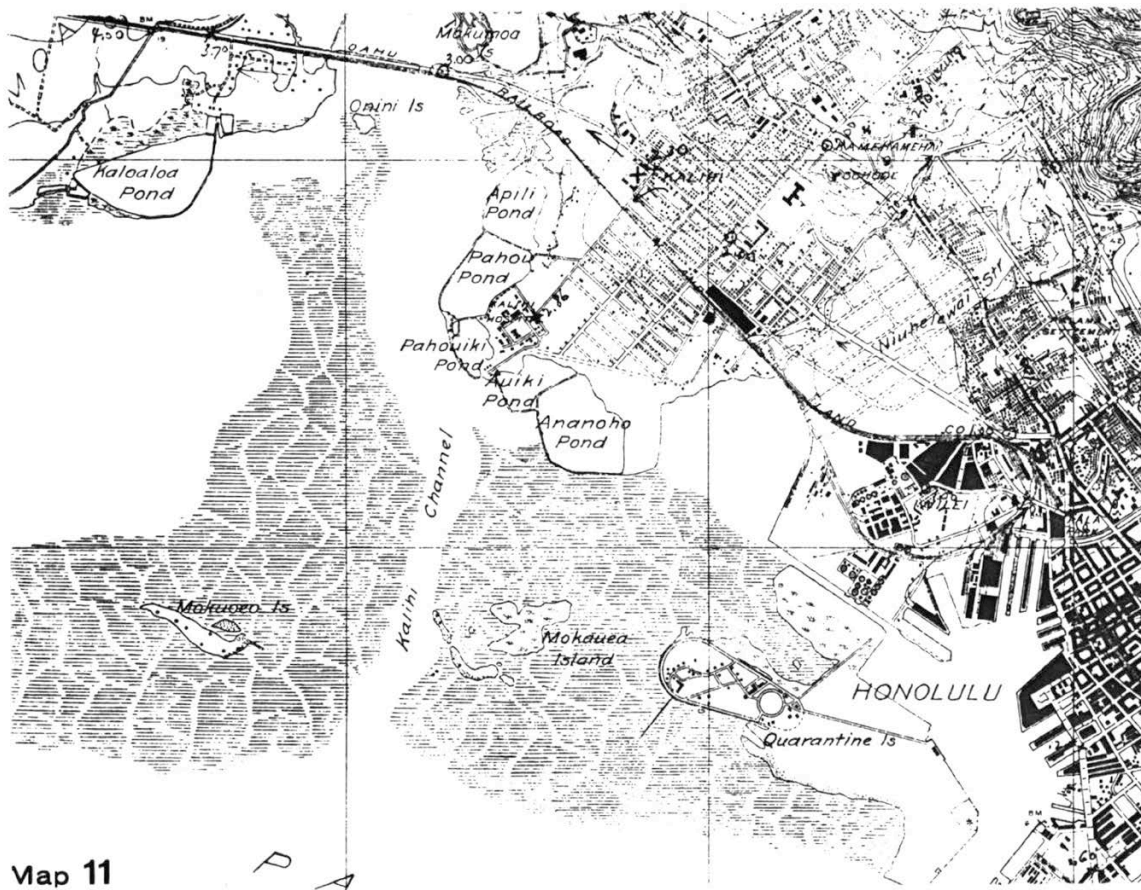


source: Lyons, C. J.

1886 Map of Honolulu Reef Titles.

Registered Map 1471.

Available at the Hawai'i Land Survey Division, Department of Accounting and General Services, 1151 Punchbowl St., Room 210, Honolulu.



source: U.S. Geological Survey, Hi, Territory Survey, Honolulu Quad  
1927-1928

Available at the Hawai'i Land Survey Division, Department of Accounting and General  
Services, 1151 Punchbowl St., Room 210, Honolulu.



## APPENDIX C: IRB DOCUMENTATION



UNIVERSITY  
of HAWAII  
MĀNOA

Office of Research Compliance  
Human Studies Program

October 7, 2014

TO: Jandi Qutoriano  
Principal Investigator  
School of Architecture

FROM: Denise A. Lin-DeShetler, MPH, MA  
Director

A handwritten signature in black ink, appearing to read "Denise A. Lin-DeShetler".

SUBJECT: CHS #22528- "Indigenous Peoples and Climate Change: A Study of Mokuaea Island"

This letter is your record of the Human Studies Program approval of this study as exempt.

On October 7, 2014, the University of Hawai'i (UH) Human Studies Program approved this study as exempt from federal regulations pertaining to the protection of human research participants. The authority for the exemption applicable to your study is documented in the Code of Federal Regulations at 45CFR 46.101(b)(Exempt Category 2).

Exempt studies are subject to the ethical principles articulated in The Belmont Report, found at <http://www.hawaii.edu/irb/html/manual/appendices/A/belmont.html>.

Exempt studies do not require regular continuing review by the Human Studies Program. However, if you propose to modify your study, you must receive approval from the Human Studies Program prior to implementing any changes. You can submit your proposed changes via email at [uhirb@hawaii.edu](mailto:uhirb@hawaii.edu). (The subject line should read: Exempt Study Modification.) The Human Studies Program may review the exempt status at that time and request an application for approval as non-exempt research.

In order to protect the confidentiality of research participants, we encourage you to destroy private information which can be linked to the identities of individuals as soon as it is reasonable to do so. Signed consent forms, as applicable to your study, should be maintained for at least the duration of your project.

This approval does not expire. However, please notify the Human Studies Program when your study is complete. Upon notification, we will close our files pertaining to your study.

If you have any questions relating to the protection of human research participants, please contact the Human Studies Program at 956-5007 or [uhirb@hawaii.edu](mailto:uhirb@hawaii.edu). We wish you success in carrying out your research project.

1960 East-West Road  
Biomedical Sciences Building B104  
Honolulu, Hawai'i 96822  
Telephone: (808) 956-5007  
Fax: (808) 956-8683

## RECRUITMENT FLYER

The University of Hawai'i is conducting a study:

*Indigenous Peoples and Climate Change: a study of Mokauea Island*

### **Are you over the age of 18?**

If the answer is **YES...**

Jandi Quitoriano would like to invite you to participate in a research study.

**The purpose** of this study is to learn and understand the use of this area and the relationship of Mokauea Island to its users. The study will supplement my architecture doctoral thesis which analyzes climate change and the effects on indigenous peoples, using Mokauea as the geographical focus.

#### **The study will include:**

A quick anonymous survey, distributed and collected on site.

The survey consists of 9 questions.

The survey should take approximately 10 minutes to complete.

**If there are any questions or to learn more about the study please ask directly,  
or call jandi Quitoriano at 808.216.9040**



## SURVEY

Doctorate Research for:  
*Indigenous Peoples and Climate Change: a study of Mokauea Island*

Jandi Quitariano  
University of Hawaii Manoa | School of Architecture

### Survey

1. Are you a local resident or a visitor? (please circle one)
2. Are you of Native Hawaiian decent?  
☐ Yes ☐ No
3. What brings you here today?
4. How often do you frequent this area?  
☐ once a year ☐ once a month ☐ once a week + ☐ first time
5. Do you feel safe in this area?  
☐ Yes ☐ No
6. What is your favorite part of this area?
7. Have you been to Mokauea Island?  
☐ Yes ☐ No
8. Have you participated in conservation efforts on Mokauea Island?  
☐ Yes ☐ No
9. If you could see some sort of development here, what would it be?

## INTERVIEW

Doctorate Research for:

*Indigenous Peoples and Climate Change: a study of Mokauea Island*

Jandi Quitoriano

University of Hawaii Manoa | School of Architecture

### Interview Questions

1. Please state your name and your relationship to Mokauea Island. If you are a resident of the island, please detail your genealogy or specify how long and how your family has been connected to Mokauea.
2. In your own words, what makes this place special and therefore significant?
3. In your own words, briefly describe the history of Mokauea Island and the surrounding areas.
4. Are there any mo'olelo or stories related to Mokauea?
5. The lease of Mokauea is coming to an end soon. Are there any plans of a lease extension or any information related to the continuance of residence on Mokauea?
6. There has been a plan of action enforced by the State Government in relation to the granted 65 year lease of Mokauea Island that includes an educational program for students to learn about traditional fishing and the reef environment. What efforts have been made thus far? What are the future plans?
7. There have been many conservation efforts in regards to the preservation of Mokauea. Could you tell me your involvements in this movement?
8. Because of recent publicity of the Island, there has been a growing awareness and visitation to the area. Do you see this as a good or bad thing? Why?
9. It is a known fact that development on Oahu is inevitable. If the state or a private agency were to develop on or near Mokauea Island, what would you like to see?
10. It is also predicted that the sea level will rise. Do you believe this will affect Mokauea Island? Has there been any conversations about sea level rise and its effects?

11. In terms of development, what would you like to see being built, or changed, or added, or taken away, or fixed? (use given base maps to detail and explain)
12. What do you see happening with Mokauea Island in the future? Does this view differ from what you would WANT to see happening in the future? If so, please explain.
13. Please explain your current situation, in terms of electricity, water, sewage, etc.
14. Currently, there has been a switch to composting toilets. Could you identify the location of these toilets on the maps provided? How do you feel about composting toilets? What did you do/use before then?
15. Self sustainability is a possibility for Mokauea. What is needed to ensure this?
16. Under the assumption that you would like to stay on Mokauea, why do you want to stay here?
17. What are the biggest challenges that Mokauea faces?
18. Any final/additional comments?

## REFERENCES

- Albert, J.A., A. Trinidad, D. Boso and A.J. Schwarz. *Coral Reef Economic Value and Incentives for Coral Farming in Solomon Islands, Solomon Islands*, Policy Brief, Penang, Malaysia: CGIAR Research Program on Aquatic Agricultural Systems (2012). Accessed November 18, 2014.  
[http://pubs.iclarm.net/resource\\_centre/WF\\_3163.pdf](http://pubs.iclarm.net/resource_centre/WF_3163.pdf).
- All About Mangrove. "Mangrove in Hawaii." Accessed February 20, 2015. <https://mangrove.wordpress.com>.
- Alternative Hawaii. "Hawaii History: Post-Contact." Accessed March 26, 2014. <http://www.alternative-hawaii.com/hacul/history1.htm>.
- Apple, Russel A. *The Hawaiian Thatched House*. United States Department of the Interior, 1971.
- Apple, Russell and William Kikuchi. *Ancient Hawaii Shore Zone Fishponds: An Evaluation of Survivors for Historical Preservation*. Hawaii: State of Hawaii Department of Land and Resources, 1975.
- ArchDaily. "Qunli Stormwater Wetland Park / Turenscape." Accessed February 14, 2015.  
<http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/>. "Welcome to Turenscape," Turenscape, accessed February 14, 2015, <http://www.turenscape.com/English/projects/project.php?id=435>.
- ArchDaily. "Red Ribbon Park/Turenscape." Accessed February 14, 2015. <http://www.archdaily.com/445661/red-ribbon-park-turenscape/>.
- Asia Indigenous Peoples Pact 2012. "Indigenous Peoples and Climate Change Adaptation in Asia." Accessed September 23, 2014.  
[http://www.iwgia.org/iwgia\\_files\\_publications\\_files/0656\\_IPs\\_and\\_Climate\\_Change\\_Adaptation\\_in\\_Asia.pdf](http://www.iwgia.org/iwgia_files_publications_files/0656_IPs_and_Climate_Change_Adaptation_in_Asia.pdf).
- Berkes, Fikret and Julian T. Inglis, ed. *Traditional Ecological Knowledge: Concepts and Cases*. Canada: International Program on Traditional Ecological Knowledge, 1993.
- Bernard, Thuiller P. "Introduction. Global change and biodiversity: future challenges." *Biology Letter 4* (2013). 553-555.
- Black Pearls Inc. *A Pearl Farm and Pearl Oyster Reef Reseeding Project*. Hawaii: Department of Land and Natural Resources, 2001. Accessed December 12, 2014.  
[http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf).
- City and County of Honolulu. "Honolulu Harbor." Accessed February 12, 2014.  
<http://www1.honolulu.gov/refs/nco/nb15/12/15marmin.htm>.
- Commander U.S. Pacific Fleet. "Marine Surveys." Accessed January 30, 2015.  
[http://www.cpf.navy.mil/content/foia/ea/appendix\\_j.pdf](http://www.cpf.navy.mil/content/foia/ea/appendix_j.pdf).

- Coral Reef Conservation Program. "About Corals." Accessed December 12, 2014. <http://coralreef.noaa.gov>.
- Crutzen, Paul, John R. McNeill and Will Steffen. "The Anthropocene: Are Humans Now Overwhelming the Forces of Nature." *Ambio: A Journal of the Human Environment* 36(8):614-621 (2007). Accessed January 8, 2015. doi: [http://dx.doi.org/10.1579/0044-7447\(2007\)36\[614:TAAHNO\]2.0.CO;2](http://dx.doi.org/10.1579/0044-7447(2007)36[614:TAAHNO]2.0.CO;2).
- Dictionary.com. "Culture." Dictionary.com, accessed January 22, 2014, <http://dictionary.reference.com/browse/culture?s=t>.
- Duit, Andreas, Victor Galaz, Katarina Eckerberg, and Jonas Ebbesson. "Governance, Complexity, and Resilience." *Global Environmental Change* Volume 20 (2010). 363-368. Accessed November 12, 2014. <http://www.sciencedirect.com/science/article/pii/S095937801000035X>.
- Facebook. "Ho'ola Mokauea Island." Accessed April 22, 2014. <https://www.facebook.com/HoolaMokaueaisland>.
- Fathy, Hassan, Walter Shearer and Abd-el-rahman Ahmed Sultan, eds. *Natural Energy and Vernacular Architecture: Principles and Examples with Reference to Hot Arid Climates*. Chicago: The United Nations University, 1986.
- Freeman, Milton M. R. "The Nature and Utility of Traditional Ecological Knowledge." *Canadian Arctic Resources Committee*. Accessed January 12, 2015. <http://www.carc.org/pubs/v20no1/utility.htm>.
- Fringe. "Subsidence due to peat decomposition in the Netherlands" Accessed May 2, 2013. [http://earth.esa.int/fringe07/participants/559/pres\\_559\\_carocuen.pdf](http://earth.esa.int/fringe07/participants/559/pres_559_carocuen.pdf).
- Greene, Linda Wendel. *A Cultural History of Three Traditional Hawaiian Sites on the West Coast of Hawai'i Island*. Denver Service Center: United States Department of the Interior National Park Service, 1993.
- Hardy, E.S. Craighill, Elizabeth Green Handy, and Mary Kawena Pukui. *Native Planters in Old Hawaii: their Life, Lore, and Environment*. Bernice P. Bishop Museum bulletin 233. Honolulu: Bishop Museum Press, 1991. 294-295.
- Hawaii Business. "High-rises Design Inspired By the Ocean." Accessed July 12, 2014. <http://www.hawaiibusiness.com/high-rises-design-inspired-by-the-ocean/>.
- Hawaii History. "Ahupua'a." Accessed October 22, 2014. <http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&CategoryID=299>.
- Hawaii QuickFacts from the US Census Bureau. "United States Census Bureau." Accessed September 20, 2014. <http://quickfacts.census.gov/qfd/states/15000.html>.
- Hawaii Tribune-Herald. "Bills Promote Food Self-Sufficiency." Accessed January 3, 2015. <http://hawaiitribune-herald.com/sections/news/local-news/bills-promote-food-self-sufficiency.html>.
- Historic Hawaii Foundation. "Most Endangered Sites." Accessed December 18, 2014. <http://historichawaii.org/mes/>.

Hollinger, David A., ed. *The Humanities and the Dynamics of Inclusion Since World War II*. Maryland: Johns Hopkins University Press, 2006.

Hui Kū Maoli Ola. "Company History." Accessed February 18, 2015. <http://www.hawaiiannativeplants.com/company-history/>.

Hui Kū Maoli Ola. "Our Mission." Accessed February 18, 2015. <http://www.hawaiiannativeplants.com/our-mission/>.

Hunn, Eugene, N. Williams and G. Baines, eds. *What is traditional ecological knowledge? In Traditional ecological knowledge: wisdom for sustainable development*. Canberra: Centre for Resource and Environmental Studies, 1993.

Infoplease. "Hawaii." Accessed January 2, 2015. <http://www.infoplease.com/us-states/hawaii.html>.

Ingalls, D. S. c/o U. S. Naval Air Station. *U.S. Naval Air Station, Honolulu, T. H. History*. Department of the Interior: 1945.

Inside Climate News. "6 of the World's Most Extensive Climate Adaptation Plans." Accessed December 13, 2014. <http://insideclimatenews.org/news/20130620/6-worlds-most-extensive-climate-adaptation-plans>.

International Labour Organization. "Convention No. 169." Accessed September 22, 2014. <http://www.ilo.org/indigenous/Conventions/no169/lang--en/index.htm>.

International Work Group for Indigenous Affairs. "Who Are The Indigenous Peoples." Accessed August 12, 2014. <http://www.iwgia.org/culture-and-identity/identification-of-indigenous-peoples>.

Inuit Circumpolar Council-Greenland. "Welcome." Accessed February 17, 2013. <http://inuit.org/dk.html>.

JDS Architects. "Mermaid Inspired Building." Accessed February 12, 2013. <http://inhabitat.com/mermaid-inspired-aquatic-building-by-jds-architects/>.

Jon Letman, "Keeping House," *The Bulletin of the National Tropical Botanical Garden*, volume xxx-1-2, Spring-Summer 2013, accessed January 2, 2015, [http://ntbg.org/cms\\_files/KeepingHouse\\_copyright-NTBG.pdf](http://ntbg.org/cms_files/KeepingHouse_copyright-NTBG.pdf).

Joni Bagoood (resident of Mokauea) Interview by Jandi Quitoriano. March 19, 2015. Sample available in Appendix C.

Kahumana Community. "Home Page." Accessed February 20, 2015. <http://www.kahumana.org>.

Kai Makana. "Mission, Vision & Values." Accessed March 26, 2014. <http://www.kaimakana.org/mission.htm>.

Kai Makana. "Mokauea Island Restoration Project." Accessed March 26, 2014. <http://www.kaimakana.org/mirp.htm>.

Kainani. "Mokauea Island." Accessed June 2, 2014. <http://kainani.hpu.edu/cfung/mokouea-moreInfo.htm>.



Kanahele, George S. *Kū Kanaka-Stand Tall: A Search for Hawaiian Values*. Honolulu: University of Hawaii Press, 1986.

Kiraishi, Ku'uwehi and Keōpūlaulani Reelitz. "Self-Determine Nation." *Mana Magazine*, September 2014.

Know. "Basics of Climate Change" Accessed September 17 2014.

[http://know.climateofconcern.org/index.php?option=com\\_content&task=article&id=115](http://know.climateofconcern.org/index.php?option=com_content&task=article&id=115).

Kumu Pono Associates LLC. "Mālama Pono I Ka 'Āina-An Overview of the Hawaiian Cultural Landscape." Accessed November 8, 2014. <http://www.kumupono.com/Hawaiian%20Cultural%20Landscape.pdf>.

Lee, Pali Jae. *Ho'opono*. Lightning Source Inc., 2007. 28.

LegiScan. "Hawaii Senate Bill 2485." Accessed April 18, 2014. <https://legiscan.com/HI/text/SB2485/id/464353>.

Lyons, Curtis J., trans. and W.D. Alexander, introduction. "The Song of Kualii, of Hawaii, Sandwich Islands." *The Journal of the Polynesian Society* volume 2 (1893):160-178.

Macchi, Mirjam, Gonzalo Oviedo, Sarah Gotheil, Katharine Cross, Agni Boedhihartono, Caterina Wolfangel and Matthew Howell. *Indigenous and Traditional Peoples and Climate Change-Issues Paper*. IUCN, 2008.

Malama Aina. "Loko I'a-Fishponds." Malama Aina. Accessed January 10, 2015. <http://malamaaina.org>.

Mana. "Mokauea Lives And Breathes." Accessed April 17, 2014. <http://welivemana.com/articles/mokauea-lives-and-breathes>.

Maui Community College. "Kumulipo." Accessed February 2, 2015.

<http://www2.hawaii.edu/~zinner/101/students/PuaKumulipo/kumulipo.html>.

McLean, Kristy Galloway. *Advance Guard: Climate Change Impacts, Adaptation, Mitigation and Indigenous Peoples- A compendium of Case Studies*. Australia: United Nations University, 2010.

Mitchel, Donald D. Kilolani. *Resource Units in Hawaiian Culture*. Honolulu, Hawaii: Kamehameha Schools, 1992.

MoMA. "SCAPE: Oyster-tecture | MoMA Rising Currents." Accessed February 12, 2015.

<http://www.scapestudio.com/projects/oyster-tecture/>.

MoMA. "Exhibitions." Accessed December 20, 2014. <http://www.moma.org/visit/calendar/exhibitions/1031>.

Napoka, Nathan. *Mokauea Island A Historical Study*. Hawaii: Department of Land and Natural Resources, 1976.

NASA. "Land Reclamation Rotterdam." Accessed March 12, 2013.

<http://earthobservatory.nasa.gov/IOTD/view.php?id=47122>.

- NASA. "The Current and Future Consequences of Global Change," Accessed January 12, 2015.  
<http://climate.nasa.gov/effects/>.
- National Geographic. "Traditional Ecological Knowledge (TEK): An Interview With Dr. Michael Hutchins." Accessed November 21, 2014. <http://newswatch.nationalgeographic.com/2014/01/11/indigenous-people-their-interface-with-wildlife-an-interview-with-dr-michael-hutchins/>.
- National Public Radio. "Hawaiians Seek Same Rights as Americans Indians." Accessed January 2, 2015.  
<http://www.npr.org/templates/story/story.php?storyId=4762516>.
- Netherlands Centre for Indigenous Peoples. "Definition of Indigenous Peoples." Accessed September 22, 2014.  
<http://indigenousoeoples.nl/indigenous-peoples/definition-indigenous>.
- NOAA Climate Program Office. "Global Sea Level Rise Scenarios for the United States National Climate Assessment." Accessed January 12, 2015. <http://cpo.noaa.gov/Home/AllNews/TabId/315/ArtMID/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx>.
- OECD Glossary of Statistical Terms. "Fishing Community," Accessed December 2, 2014.  
<https://stats.oecd.org/glossary/detail.asp?ID=993>.
- Office of the Law Revision Counsel United States Code. "42 USC 11711: Definitions" Accessed October 12, 2014.  
<http://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title42-section11711&num=0&edition=prelim>.
- Oliveira, Katrina-Ann R. Kapa'anaokaloakeola Nakoa. "Wahi A Kahiko: Place Names as Vehicles of Ancestral Memory." *AlterNative: An International Journal of Indigenous Peoples*, Vol. 5 Issue 2 (2009): 100.
- Oppenheimer, M. and A. Petsonk. *Article 2 of the UNFCCC: Historical Origins, Recent Interpretations*. Princeton University: 2004.
- Pacific Worlds. "On the Reef." Accessed June 2, 2014. <http://www.pacificworlds.com/nuuanu/sea/reef.cfm>.
- Parks and Helber, Hastert, and Fee Planners. *Kawainui-Hāmākua Master Plan Update Pamphlet*. Hawaii: State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife and Division of State, 2011. Accessed February 20, 2015, <http://www.hhf.com/kawainui/Images/DRAFT%20Kawainui-Hamakua%20Master%20Plan.pdf>.
- Pretty, Jules et al. *How do Biodiversity and Culture Intersect*. Sustaining Cultural and Biological Diversity In a Rapidly Changing World: Lessons for Global Policy Conference, organized by American Museum of Natural History's Center for Biodiversity, 2008. Accessed September 24, 2014.  
<http://www.greenexercise.org/pdf/How%20do%20biodiversity%20and%20culture%20intersect.pdf>.
- Pukui, May Kawena, Samuel H. Elbert and Esther T. Mookini. *Place Names of Hawaii*. Hawaii: University of Hawaii Press, 1974.

- Quitoriano, Jandi. "Visit to Mokauea Island." Field trip excursion. Conducted by Ho'ola Mokauea, Honolulu, multiple dates, 2014-2015.
- Quitoriano, Jandi. "Visitor Information." Survey. February 28, 2015. Sample available in Appendix C.
- Rodgers, S. Ku'ulei, Neil A. Sims, Dale J. Sarver and Evelyn F. Cox. *Distribution, Recruitment, and Growth of the Black-Lip Pearl Oyster, Pinctada margaritifera, in Kāne'ohe Bay, O'ahu, Hawai'i*. Pacific Science (2000), vol. 54, no 31-38. Accessed January 4, 2015.  
<https://scholarspace.manoa.hawaii.edu/bitstream/handle/10125/1596/v54n1-31-38.pdf?sequence=1>.
- Rudofsky, Bernard. *Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture*. Mexico: University of Mexico Press, 1987.
- Sacred Texts. "Papa and Wakea." Accessed December 4, 2014. <http://www.sacred-texts.com/pac/ku/ku23.htm>.
- Sacred Texts. "The Kumulipo Translated by Queen Liliuokalani." Accessed January 12, 2015. <http://www.sacred-texts.com/pac/lku/>.
- Salick, Jan and Anja Byg. "Indigenous Peoples and Climate Change." *Missouri Botanical Garden*, May 2007. Accessed August 22, 2014. [http://www.ecdgroup.com/docs/lib\\_004630823.pdf](http://www.ecdgroup.com/docs/lib_004630823.pdf).
- SEA Semester. "SEA Semester | Study Abroad with SEA Semester: Ocean Science & Sailing Program - Nautical, Maritime, & Oceanography Studies | SPICE Atlas Project: Rangiroa." Accessed September 27, 2014.  
[http://www.sea.edu/spice\\_atlas/rangiroa\\_atlas/polynesian\\_migration](http://www.sea.edu/spice_atlas/rangiroa_atlas/polynesian_migration).
- Solent Marine Ltd. "Simbro." Accessed February 20, 2015. [http://www.solentmarine.com/simbro\\_system.html](http://www.solentmarine.com/simbro_system.html).
- State of Hawaii Department of Land and Natural Resources. "Request for Extension of Notice of Default." Accessed April 20, 2014. <http://hawaii.gov/dlnr/chair/meeting/submittals/090424/D-Land-Submittals-D7.PDF>.
- Stocker et al., eds., *IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA: 2013. doi:10.1017/CB09781107415324.
- Stone, Dan. "Conservation on the Half Shell: Oysters Help Clean New York's Dirty Harbor." *National Geographic Magazine*, (2013). Accessed December 12, 2014.  
<http://voices.nationalgeographic.com/2013/06/07/conservation-on-the-half-shell-oysters-help-clean-new-yorks-dirty-harbor/>.
- Strauss, Claude Levi. *The Savage Mind*. Great Britain: The Garden City Press Limited, 1962.
- Taragan, Hana. "Architecture in Fact and Fiction: The Case of the New Gourn Village in Upper Egypt." *Muqarnas* Volume 16 (1999): 69. Accessed September 9, 2014.  
[http://www.academia.edu/5542639/Dpc1577\\_1\\_hassan\\_fathi](http://www.academia.edu/5542639/Dpc1577_1_hassan_fathi).

The Howard Hughes Corporation. "Home Page." Accessed February 14, 2015.  
<http://www.howardhughes.com/index.php>.

The Senate Twenty-fifth Legislature 2010. "S.B. NO. 2485, A Bill For an Act, Relating to Mokauea Island." State of Hawaii: 2010. Accessed June 6, 2014. <https://legiscan.com/HI/text/SB2485/id/464353/Hawaii-2010-SB2485-Introduced.html>.

Turenscape. "Welcome to Turenscape," Accessed February 14, 2015.  
<http://www.turenscape.com/english/projects/project.php?id=336>.

UN General Assembly. *United Nations Declaration on the Rights of Indigenous Peoples: Adopted by the General Assembly on 13 September 2007, Pocket Sized Format*, ed. Geneva: UHCHR, 2008.

UNFCCC. "UN Climate Change Newsroom." Accessed September 9, 2014. <http://newsroom.unfccc.int>.

United Nations Forum on Indigenous Issues. "Indigenous Peoples at the United Nations." Accessed September 12, 2014. <http://undesadspd.org/indigenouspeoples.aspx>.

United Nations Framework Convention on Climate Change. "Glossary of Climate Change Acronyms." Accessed January 8, 2014. [http://unfccc.int/files/documentation/text/html/list\\_search.php?what=&val=&valan=a&anf=0&id=10](http://unfccc.int/files/documentation/text/html/list_search.php?what=&val=&valan=a&anf=0&id=10).

United Nations Permanent Forum on Indigenous Issues. "Who are Indigenous Peoples." Accessed September 22, 2014. [http://www.un.org/esa/socdev/unpfii/documents/5session\\_factsheet1.pdf](http://www.un.org/esa/socdev/unpfii/documents/5session_factsheet1.pdf).

United States Environmental Protection Agency. "Climate Change Science Overview." Accessed September 20, 2014. <http://www.epa.gov/climatechange/science/overview.html>.

United States Environmental Protection Agency. "Climate Concepts." Accessed September 20, 2014. <http://www.epa.gov/climatechange/students/basics/concepts.html>.

University of California Museum of Paleontology. "The Holocene Epoch." Accessed January 10, 2015. <http://www.ucmp.berkeley.edu/quatarnary/holocene.php>.

UP Experience via WaterStudio. "Float! Flexible Land on Aquatic Territory." Accessed February 8, 2015. <http://www.waterstudio.nl/vision>.

Vernacular Architecture. "Vernacular Architecture – Definition." Accessed March 20, 2014. <http://www.vernaculararchitecture.com>.

Vincent Callebaut Architectures. "Lilypad, A Floating Ecopolis For Climate Refugees." Accessed March 20, 2012. <http://vencent.callebaut.org/page1-img-lilypad.html>.

WaterStudio. "Vision," Accessed February 8, 2013. <http://www.waterstudio.nl/vision>.



## FIGURE REFERENCES

- American Society of Landscape Architects. "The Red Ribbon, Tanghe River Park." Accessed December 6, 2014.  
<http://www.asla.org/sustainablelandscapes/redribbon.html>.
- Aquaculture Planning & Advocacy, LLC. "Project Location and Vicinity." Accessed November 18, 2014.  
<http://dlnr.hawaii.gov/occl/files/2013/08/3719-Mamala-Bay-Mariculture-FEA.pdf>.
- ArchDaily. "Qunli Stormwater Wetland Park / Turenscape." Accessed December 6, 2014.  
[http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/52799d8de8e44e8654000098\\_qunli-stormwater-wetland-park-turenscape\\_qunli08-jpg/](http://www.archdaily.com/446025/qunli-stormwater-wetland-park-turenscape/52799d8de8e44e8654000098_qunli-stormwater-wetland-park-turenscape_qunli08-jpg/).
- Bio Rock. "The Gili Eco Trust." Accessed January 18, 2015. <http://www.biorock.net>.
- Black Pearls, Inc. "Location of Project Site at Keehi Lagoon." Accessed November 18, 2014.  
[http://oeqc.doh.hawaii.gov/Shared%20Documents/EA\\_and\\_EIS\\_Online\\_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf](http://oeqc.doh.hawaii.gov/Shared%20Documents/EA_and_EIS_Online_Library/Oahu/2000s/2001-05-08-OA-FEA-KEEHI-LAGOON-PEARL-FARM.pdf).
- David gray. "Some of the most vulnerable Pacific nations – such as Kiribati (above) – ‘are at high risk of debt distress’ but do not qualify for relief." Accessed February 18, 2015. <http://www.theguardian.com/global-development-professionals-network/2014/oct/21/un-climate-debt-swap-is-fundamentally-unjust-say-development-agencies>.
- Department of Planning & Permitting Honolulu Land Information System (HoLIS). "GIS Data." Accessed multiple dates, years 2014-2015. <http://gis.hicentral.com/data.html>.
- Ed Greevy. "O Ethel ma Mokauea." Accessed March 2, 2015. <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1haw-Zz-1---10-about---00031-00110escapewin-00&a=d&c=edgreevy&cl=CL6.7&d=D417>
- Ed Greevy. "Loko I'a Ma Mokauea." Accessed March 2, 2015. <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1haw-Zz-1---10-about---00031-00110escapewin-00&a=d&c=edgreevy&cl=CL2.6&d=D431>.
- Ed Greevy. "Mokauea Fishermen." Accessed March 2, 2015. <http://ulukau.org/apo/cgi-bin/edgreevy?e=d-0edgreevy--0-0--010---4---Doc-text---0-1l--1en-Zz-1---10-about---00031-00110escapewin-00&a=d&c=edgreevy&cl=CL3.8&d=D184>
- Environmental Protection Agency. "Interactions within the Climate System." Accessed November 8, 2014.  
<http://epa.gov/climatechange/science/future.html>.
- Google. "Google Maps." Accessed multiple dates, years 2014-2015. <https://www.google.com/maps>.



Hawaiian Sustainability Foundation. "Ahupua'a." Accessed January 22, 2015.

<http://www.hawaiiansustainability.org/ahupuaa.php>.

HCDA. "Hawaii Construction Boom." Accessed February 22, 2015. <http://www.honolulumagazine.com/Honolulu-Magazine/April-2014/Hawaii-Construction-Boom-New-Developments-Coming-to-Honolulu-North-Shore-Central-West-and-Windward-Oahu/>.

Heard Dutch Here. "The Netherlands." Accessed December 7, 2013. <http://www.hearddutchhere.net/NL1650.html>.

HHF Planners. "Kawainui-Hāmākua Marsh Complex Master Plan." Accessed January 28, 2015.

<http://www.hhf.com/kawainui/purpose.html>

Historic Hawai'i Foundation. "Mokaauea, on the list for endangered historic places in Hawai'i." Accessed February 22, 2015. <http://historichawaii.org/2014/12/08/mokaauea-island-2014/>.

Image Kid. "Hawai'i Coastline." Accessed February 2, 2015. <http://imgkid.com/hawaii-beach-sunset.shtml>.

IPCC AR5. "Global Projections of Climate Change." Accessed February 20, 2015.

[http://www.climatechange2013.org/images/figures/WGI\\_AR5\\_FigSPM-8.jpg](http://www.climatechange2013.org/images/figures/WGI_AR5_FigSPM-8.jpg).

Journal of the Polynesian Society. "Polynesian Migration Triangle." Accessed January 8, 2015.

<http://www.jps.auckland.ac.nz>.

Kick the Habit: A UN Guide to Climate Neutrality. "Climate Change Global Processes and effects." Accessed February 22, 2015. <http://maps.grida.no/go/graphic/climate-change-global-processes-and-effects1>.

National Geographic "Male, Maldives." Accessed March 2, 2015.

[http://ocean.nationalgeographic.com/ocean/photos/sea-level-rise/#/sea-level04-maldives-island\\_16595\\_600x450.jpg](http://ocean.nationalgeographic.com/ocean/photos/sea-level-rise/#/sea-level04-maldives-island_16595_600x450.jpg).

NOAA. "Continuation of Keehi Lagoon Barge Channel (Marine Chart: US19367\_P2808)". Accessed January 12, 2014.

[http://www.gpsnauticalcharts.com/main/us19367\\_p2808-continuation-of-keehi-lagoon-barge-channel-nautical-chart.html](http://www.gpsnauticalcharts.com/main/us19367_p2808-continuation-of-keehi-lagoon-barge-channel-nautical-chart.html)

NOAA. "Global Sea Level Rise Projection." Accessed February 20, 2015.

<http://cpo.noaa.gov/Home/AllNews/TabId/315/ArtMid/668/ArticleID/80/Global-Sea-Level-Rise-Scenarios-for-the-United-States-National-Climate-Assessment.aspx>.

NOAA. "O'ahu Benthic Habitat Map (Frame 60)." Accessed February 22, 2015.

[http://ccma.nos.noaa.gov/products/biogeography/hawaii\\_cd/maps/a60.pdf](http://ccma.nos.noaa.gov/products/biogeography/hawaii_cd/maps/a60.pdf).

NOAA. "Shallow-water Benthic Habitats (Frame 124)." Accessed February 22, 2015.

[http://ccma.nos.noaa.gov/products/biogeography/hawaii\\_cd\\_07/maps/Frame\\_124.pdf](http://ccma.nos.noaa.gov/products/biogeography/hawaii_cd_07/maps/Frame_124.pdf).

RIMBA Project. "The RIMBA Project: between sea & jungle." Accessed January 28, 2015. <http://it.ulule.com/rimba-project/description/>.

Scape Studio. "Oyster-Tecture MoMA Rising Currents." Accessed December 6, 2014. <http://www.scapestudio.com/projects/oyster-ecture/#4>.

Star Bulletin. "The Sharing of Hā, or Breath of Life." Accessed February 2, 2015. <http://archives.starbulletin.com/2003/09/10/news/story2.html>, edited by author]

The lovely seas. "Wild black lip pearl oysters (*Pinctada margaritifera*)." Accessed February 12, 2015. <http://food.browzen.com/p/PV1tVm>.

University of Hawaii Botany Department. "Hawaiian Native Plant Genera." Accessed March 20, 2015. <http://www.botany.hawaii.edu/faculty/carr/natives.htm>.

Vincent Callebaut Architectures. "Lilypads." Accessed December 13, 2014. [http://vincent.callebaut.org/planche-lilypad\\_pl31.html](http://vincent.callebaut.org/planche-lilypad_pl31.html).

Vincent Callebaut Architectures. "Lilypads." Accessed December 13, 2014. <http://vincent.callebaut.org/page1-img-lilypad.html>.

WaterStudio. "Sea Tree." Accessed December 13, 2014. <http://www.waterstudio.nl/projects/79>.

WaterStudio. "Watervilla IJburg, Amsterdam, The Netherlands." Accessed December 13, 2014. <http://www.waterstudio.nl/projects/48>.